INSTRUCTION MANUAL

FREQUENCY-SELECTIVE VOLTMETER

MODEL 125B

PHILCO

Ford

PHILCO-FORD CORPORATION
Sierra Electronic Operation
Menlo Park, Calif. • 94025

FREQUENCY-SELECTIVE VOLTMETER MODEL 125B

(B) 2021-2920
(B-CR) 262-401
(B-Y) 251-340

A02512510D Price $5.00

March 1968

INSTRUCTION MANUAL CHANGE

Up Date Change #1

Serial Numbers: (B) 2021-2920
(B-CR) 262-401
(B-Y) 251-340

Make the following changes to the instruction manual for the Model 125B (Sierra Stock Number A02512510D) for instruments with the serial numbers indicated above. Incorporation of these changes will make the instruction manual appropriate for the particular equipment run.

Figures 3-3, 3-4, and 3-5: Delete resistor R39 and change the value of potentiometer R42 to 2.5K.

Figure 3-3: Change drawing number to E14453-5V.

Figure 3-4: Change drawing number to E14203-5S.

Figure 3-5: Change drawing number to E14201-5T.

Page 4-2: Change capacitor C3 to read

C3 CAPACITOR, 390 pf, 300 Vdcw ±2%, Silver Mica 902080391
El Menco CM-15E-391G

Page 4-4: Change drawing number of inductor L9 to SS-4493-1.

Page 4-5: Delete resistor R39 and change potentiometer R42 to read

R42 POTENTIOMETER, 2500 ohms

Page 4-7: Change drawing number of transformer T1 to SU-14189-3.

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NOTICE

WITH THE VOLTMETER CALIBRATED AND OPERATING NORMALLY, INTERNALLY GENERATED NOISE WILL DEFLECT THE METER SLIGHTLY UPSCALE. THIS NOISE SHOULD NOT EXCEED THE -20 DB MARK ON THE METER AND DOES NOT AFFECT THE MEASURING ACCURACY OVER THE SPECIFIED RANGE.

NEVER ADJUST MECHANICAL ZERO SET ON METER UNLESS POWER IS OFF.

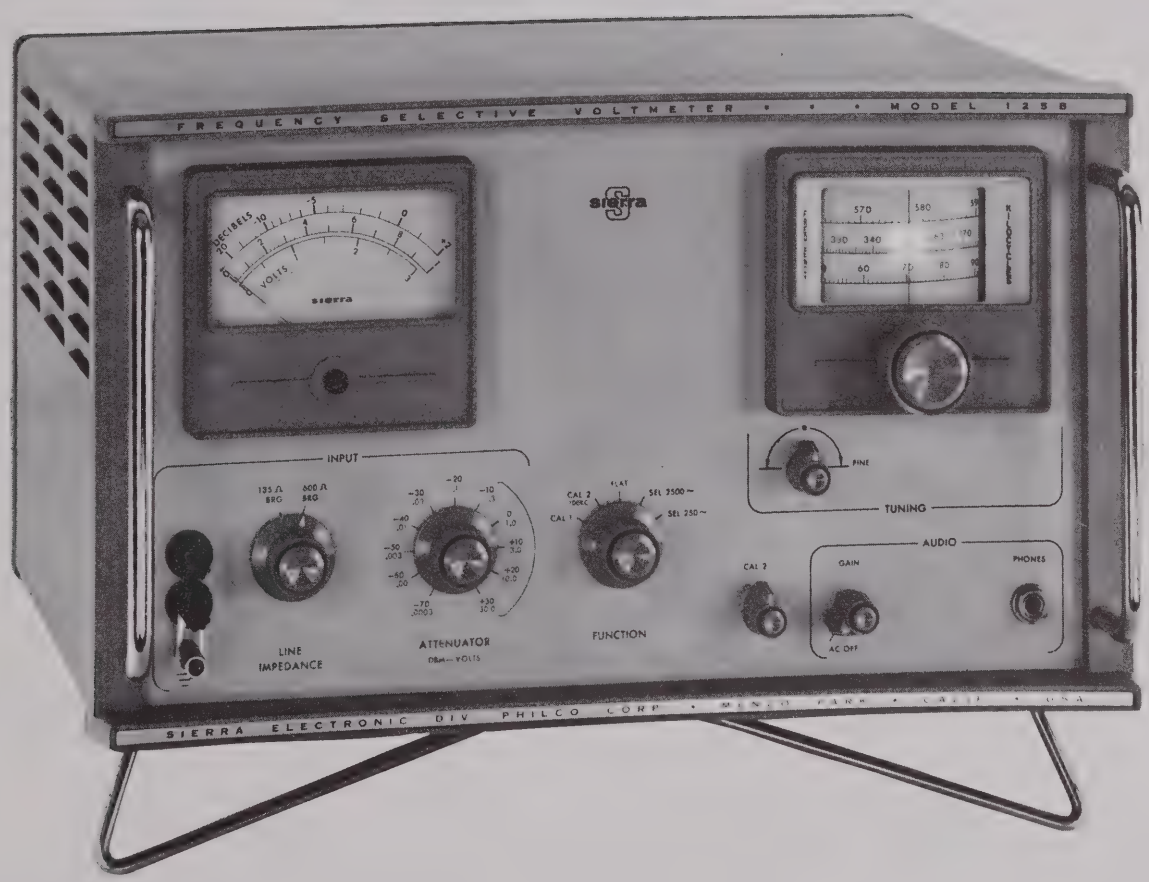


Figure 1-1. Model 125B

SECTION I
GENERAL

A. INTRODUCTION

This handbook describes the Model 125B Frequency Selective Voltmeter and its variations, Models 125B-CR and 125B-Y, manufactured by Sierra Electronic Operation, Philco-Ford Corporation, Menlo Park, California. Information contained in this handbook will enable the technician to perform operation, calibration and field maintenance procedures consistent with practices and recommendations of the manufacturer. Model 125B is illustrated in Figure 1-1. Full specifications are given in Table 1-1.

Table 1-1. Specifications, Models 125B, 125B-CR and 125B-Y

FREQUENCY RANGE		
Selective Voltmeter		
Wide Band	(2500 Hz)	10 kHz to 620 kHz
Narrow Band	(250 Hz)	3 kHz to 620 kHz
Flat Voltmeter		1 kHz to 620 kHz
INPUT LEVEL RANGE		
Selective Voltmeter		-90 dBm to +32 dBm (24.5 microvolts to 30 volts)
Flat Voltmeter		-30 dBm to +32 dBm (24.5 millivolts to 30 volts)
MEASUREMENT ACCURACY		
Selective Voltmeter		±1 dB (-80 dBm to 32 dBm)
Flat Voltmeter		±0.5 dB (20 dBm to 32 dBm)
SELECTIVE VOLTMETER BAND-PASS		
Wide Band	(2500 Hz)	2500 Hz (±200 Hz) 3 dB down 14,00 Hz Max. 60 dB down
Narrow Band	(250 Hz)	250 Hz (±50 Hz) 3 dB down 1400 Hz Max. 60 dB down
DIRECT READING		dBm with 135 ohm and 600 ohm balanced or unbalanced lines. Volts with 600 ohm balanced or unbalanced lines.

INPUT IMPEDANCE	
600 ohm position	20,000 ohms nominal
135 ohm position	4500 ohms nominal
*WE IN position	4500 ohms nominal
*EW IN position	4500 ohms nominal
*EW OUT position	4500 ohms nominal
*GR IN position	4500 ohms nominal
*GR OUT position	4500 ohms nominal
*Model 125B-Y only	
LINE BRIDGING LOSS	Less than 0.3 dB over entire frequency range, either input impedance.
TUNING ACCURACY	
Room Temperature	±1 kHz over entire tuning range
50°F to 120°F	±2 kHz over entire tuning range
SPURIOUS RESPONSE	
Harmonic Distortion	Greater than 60 dB down
Intermodulation Distortion	Greater than 60 dB down
Image Response	Greater than 50 dB down
Direct IF Response	Greater than 50 dB down
CALIBRATION OSCILLATOR	100 kHz ±0.02%
**CARRIER REINSERTION OSCILLATORS	
Lower Sideband	2.2135 MHz ±0.005%
Upper Sideband	2.2165 MHz ±0.005%
POWER INPUT	105/125 volts, 50-1000 Hz 60 watts 210-250 volts, 50-1000 Hz 60 watts (optional)
OVERALL DIMENSIONS:	
Width	17 inches
Height	10-1/8 inches
Depth	14-1/4 inches
WEIGHT	30 lbs.
AMBIENT TEMPERATURE RANGE	50°F to 120°F

**Model 125B-CR only

B. DESCRIPTION

1. Frequency Selective Voltmeter

As a frequency selective voltmeter, Model 125B tunes from 3 kHz to 620 kHz with a sensitivity variable from 24.5 microvolts to 30 volts (-90 dBm to +32 dBm) in eleven attenuator steps. Transmission lines of 60 ohms and 135 ohms impedance may be matched by use of the LINE IMPEDANCE panel control which selects the proper internal bridging circuit. Output of the instrument is read directly in dBm by algebraically adding the reading on ATTENUATOR panel control to the output meter reading. Direct voltage readings may be made in 600-ohm position.

2. Selectivity

Two crystal filters located between the mixer stages and the IF amplifier provide bandwidth of 2500 cycles and 250 cycles in frequency selective operation. Selected with the panel control marked FUNCTION, these two selectivity characteristics make the Model 125B useful for complex waveform analysis as well as for general carrier system measurements.

3. Flat Voltmeter

In addition to its frequency selective capability, Model 125B has been designed to operate as a flat ac VTVM with response essentially flat from 1 kHz to 620 kHz. In this mode of operation, a portion of the attenuator deck is by-passed so that the gain lost in switching the input signal around the mixer and IF amplifier (approximately 60 dB) is recovered by using only a portion of the input attenuation. Five attenuator steps are therefore available for flat voltmeter measurements. Range of sensitivity of Model 125B when used as a flat voltmeter is from 24.5 millivolts to 30 volts (-30 dBm to +32 dBm).

4. Model 125B-Y Variation

Sierra Model 125B-Y differs from the standard Model 125B only in that it is supplied with a front-panel 20-pin connector and an associated multi-position input selector switch to facilitate connection of a greater number of 135-ohm balanced input circuits to the voltmeter. Model 125B-Y, shown in figure 1-2, is particularly designed for compatibility with built-in maintenance facilities of certain carrier equipment installations.

5. Model 125B-CR Variation

Sierra Model 125B-CR differs from the standard Model 125B only in that it is supplied with additional internally mounted oscillators for carrier reinsertion so that Model 125B-CR may be used for monitoring single side band carrier systems. Model 125B-CR is illustrated in Figure 1-3.

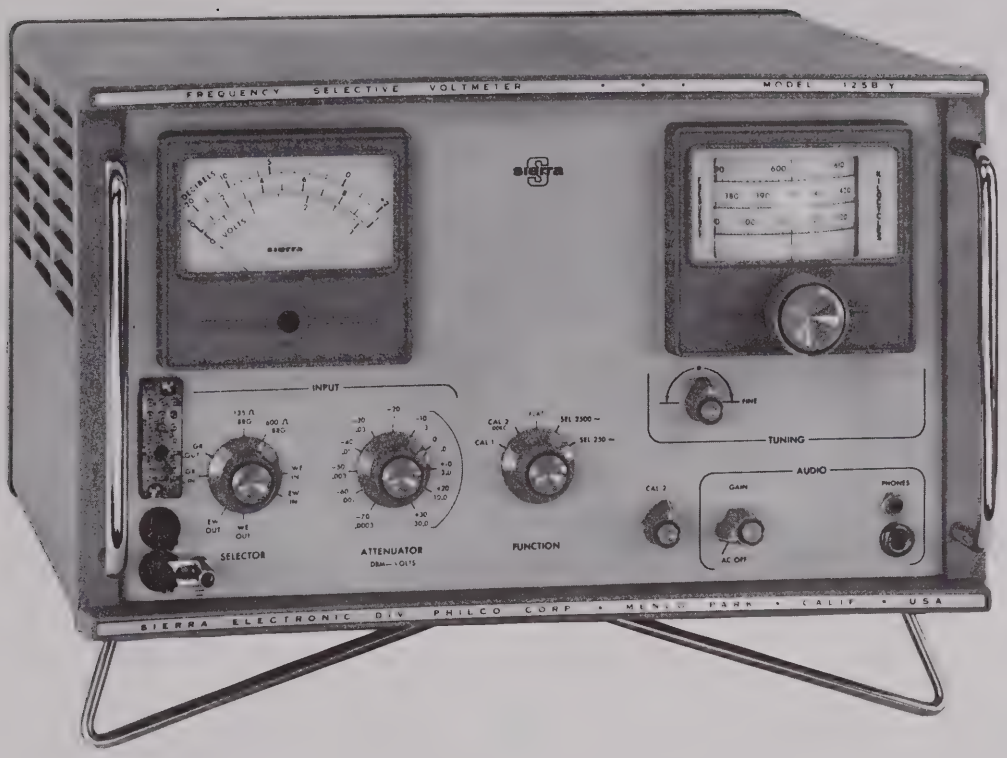


Figure 1-2. Model 125B-Y

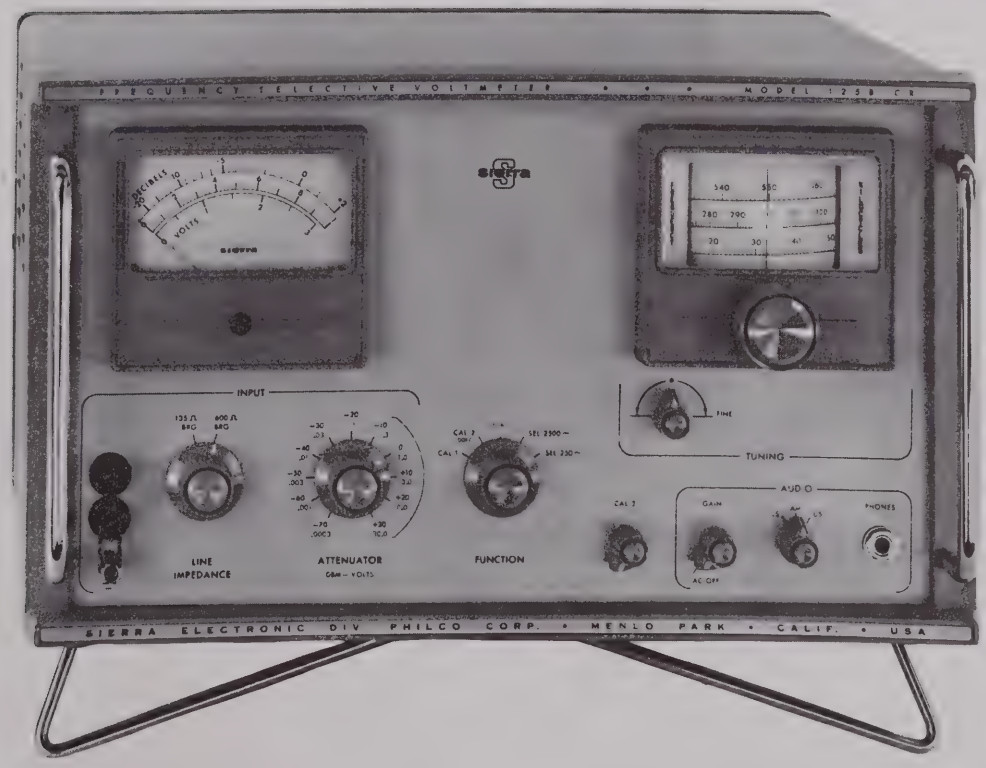


Figure 1-3. Model 125B-CR

6. Power Requirements

A power source providing 105 to 125 volts, 50/60 cycles is required. Power consumption is 60 watts. The line cord supplied with the 125B has a standard NEMA three-prong grounded plug.

7. Physical Characteristics

Model 125B is supplied from the manufacturer in either a standard metal cabinet 17 inches wide, 10-1/8 inches high, and 14-1/4 inches deep, or in 19 inch rack panel configuration measuring 19 inches wide, 12-7/32 inches high, and 12-1/4 inches deep. Weight of either instrument is about 30 pounds. All operating controls are mounted on the front panel.

8. General Construction

Modular printed circuits have been used in the voltmeter to provide direct paths and facilitate maintenance procedures. Components of each circuit are laid out on glass epoxy boards which in turn are mounted to the main chassis. Stand-offs are used to mount the circuit boards, increasing component reliability through improved cooling. Mechanical and electrical components of the local oscillator are mounted on a separate casting to maintain physical alignment and minimize variations due to temperature change and mechanical shock. The tuning drive and dial are integral components of this assembly.

C. PREPARATION

1. When shipped from the manufacturer, Model 125B is packed in a cardboard shipping carton with suitable packing and reinforcement to avoid shipping damage. To prepare instrument for use, remove the voltmeter from its shipping carton and inspect for damage. The instrument is shipped with tubes mounted; check to ascertain that all tubes are properly seated in their sockets. Prior to operating the voltmeter, a warm-up period of fifteen minutes is required to stabilize the circuitry. Power is applied by means of the line switch mounted on the audio GAIN panel control. The frequency dial light indicates power ON. Operating controls are listed in Table 1-2.

Table 1.2 Operating Controls

Description	
AC OFF, GAIN	AC power and AUDIO GAIN control.
PHONES	Headphone jack.
TUNING	Main tuning control (two-speed, in-out positioning).
FINE	Fine Tuning control
FUNCTION	Selects proper mode of operation (CAL 1, CAL 2, FLAT, SEL 2500 ~, SEL 250 ~).
ATTENUATOR	Calibrated selector reading amount of attenuation in dB, and voltage range in volts (600Ω BRG position only).
LINE IMPEDANCE	Selects 135Ω BRG or 600Ω BRG input impedance.
INPUT BINDING POST	Provide means of accepting balanced or unbalanced input signals.
LS-AM-US	(On Model 125B-CR only) Selects lower sideband, upper sideband or a-m mode of operation.
SELECTOR	(On Model 125B-Y only) Replace LINE IMPEDANCE selector, and selects eight inputs designated as follows: 135Ω BRG, 600Ω BRG, WE IN, EW IN, WE OUT, EW OUT, GR IN, GR OUT.
CAL 2	Selective Voltmeter GAIN control.

D. OPERATIONAL CALIBRATION

1. Model 125B is calibrated for operation using the internal 100 kHz oscillator. The output from this oscillator, when FUNCTION switch S3 is in CAL 1 position, feeds a low distortion 100 kHz signal to the input circuit of the voltmeter. This establishes a reference level, of approximately 0 dBm, utilizing the inherent accuracy and stability of the flat voltmeter, for the determination and adjustment of the CAL 2 (Gain) setting. Procedure for calibration follows:

1. Allow fifteen (15) minutes warmup.

2. Set attenuator at 0 dB.

3. Set FUNCTION at CAL 1.

Output meter will read approximately 0 dBm. Observe the exact reading of the meter. (Example: Meter reads -0.5 dBm.)

4. Set FUNCTION at CAL 2.

5. Adjust tuning dial for maximum output meter response at 100 kHz. Tune carefully in fine drive position (tuning knob pushed in) and peak with panel mounted FINE tuning control.

6. If necessary, adjust CAL 2 (Gain) panel control so that output meter reads the same level noted in the CAL 1 position (step c above).

(Example: Meter reading of -0.5 dBm.) Instrument is now properly adjusted for measurement of external signals.

NOTE: An exact 0 dBm reading is not required to accurately calibrate the Model 125B. The CAL 1 check measures the output of the 100 kHz oscillator accurately due to the flat voltmeter's inherent accuracy and stability. It is then only necessary to set the CAL 2 level the same as read on CAL 1.

E. EXTERNAL SOURCE CALIBRATION.

1. It may be desired to use an external oscillator for calibration of the voltmeter at a specific frequency in order to obtain the greatest possible accuracy. Procedure for external source calibration is given below.

a. Set up a stable, accurately calibrated rf signal generator with 600 ohm output, a 600 ohm attenuator, and a 600 ohm termination, preferably in the form of an indicating thermocouple. At the expense of some accuracy, a non-inductive resistor and a VTVM may be used.

b. At the desired calibration frequency, establish a signal generator level of 0 dBm (0.775 volts across the terminating resistance).

c. Apply established 0 dBm power level to the voltmeter input terminals.

d. Set LINE IMPEDANCE at 600Ω BRG.

e. Set FUNCTION at either SEL 2500 ~ or 250 ~ .

f. Set voltmeter ATTENUATOR at 0 dB.

g. Adjust tuning dial and FINE panel control for maximum indication on the output meter.

h. Adjust CAL 2 panel control for output meter reading of 0 dB.

2. External source calibration for 135 ohm circuits may be accomplished in the manner described for 600 ohm measurements, substituting 135 ohm components in the external test circuits, and with LINE IMPEDANCE selector at 135Ω BRG. Voltage across the 135 ohm termination should be 0.367 volts.

F. GENERAL MEASUREMENT

1. General circuit measurement procedure is detailed in the steps which follows:

a. Calibrate voltmeter using either procedure indicated above (See paragraph D. or E.)

b. Select mode of operation with FUNCTION switch. (FLAT, SEL 2500 ~ or SEL 250 ~ .

c. Connect signal for measurement to voltmeter input terminals.

d. Adjust tuning dial for maximum indication on output meter.

e. Peak output meter with FINE tuning panel control.

f. Set ATTENUATOR switch as required to obtain an on-scale reading.

g. To obtain signal magnitude in dBm, add ATTENUATOR reading algebraically to that of the output meter.

2. HEADPHONE MONITORING

In the SEL 2500 ~ position, a headphone of any impedance with single plug may be used to continuously monitor audio signals. A panel control, GAIN, is provided to set the audio at a comfortable listening level. Output is taken from the panel jack designated PHONES.

SECTION II
THEORY OF OPERATION

A. THEORY OF OPERATION

1. Input Circuits

Input circuitry of the voltmeter consists primarily of switch S1 and transformer T1, the low-pass filter, the attenuation network, and switch S2 which selects the desired leg of the attenuator circuitry.

2. An input signal of 600 ohms or 135 ohms impedance applied to panel binding posts J1 and J2 is matched by LINE IMPEDANCE switch S1 to the input of the voltmeter in conjunction with bridging transformer T1, and with C1, R1 and R2. Shielded cabling carries the input signal to a two-section low-pass filter comprised of inductors L1, L2, and of capacitors C2, C3 and C4. The cut-off frequency of this filter is 620 kHz. Rejection is approximately 20 dB at 1100 kHz.

3. ATTENUATOR switch S2, to which the output of the low-pass filter is applied, selects the portion of the attenuator network which corresponds to the panel marking in the 10 dB steps from -70 dB to +30 dB. Output of S2 is applied to FUNCTION selector S3.

4. In CAL 1 position, S3 feeds a 100 kHz signal from the injection oscillator directly to the flat voltmeter. In CAL 2 position, the 100 kHz signal is fed through a portion of the attenuator network (0 dB position), through the mixer and crystal filter, FL1, to the IF amplifier, and then to the flat voltmeter. The input signal is applied directly to the flat voltmeter in FLAT position of the FUNCTION switch, and to the mixer input in SEL 2500 ~ and SEL 250 ~ positions.

5. Mixer and Modulator

Mixer V1 is essentially an amplifier, the gain of which is controlled at a rate which is equal to the local oscillator frequency (2.218 MHz to 2.835 MHz). The balanced modulator, consisting of CR4, CR5, CR6, and their associated components, acts as a switch which returns the cathode of V1 to ac ground through R26 and C70. During half of the input cycle to the modulator, the balanced diodes conduct, and the modulator output is seen by C70 to be at ac ground potential. Capacitor C70 by-passes cathode resistor R27 allowing V1 to function as an amplifier whose gain is on the order of 20 dB, with R26 providing the cathode bias. During the other half of the input cycle, the diodes are non-conducting, and the modulator output is seen as a high impedance by C70. This places R27 in the cathode circuit of V1, biasing it to the point that gain through the mixer stage is about unity. Therefore, because the rf voltage component from the local oscillator has been balanced out in the

modulator, there are high order components in the mixer whose frequencies are the sum and difference of the input signal and the local oscillator signal, but essentially no rf voltage appears in the mixer (local oscillator signal is down 35 dB to 50 dB at modulator output). Therefore, the local oscillator may be tuned within 3 kHz of the IF frequency without feeding through the mixer IF section where it would otherwise appear as a spurious signal giving an erroneous indication on the output meter. The plate tank of the mixer is tuned to the difference frequency (2.215 MHz) of the mixer components. The signal is then fed through the cathode follower V2 to crystal filter FL1 or FL2.

6. Local Oscillator

The local oscillator, V10, which provides the switching signal for the balanced modulator, tunes from 2.218 MHz to 2.835 MHz, providing an intermediate frequency of 2.215 MHz when mixed with 3 kHz to 620 kHz input signals. The circuit is highly stable, temperature compensated Hartley oscillator, transformer coupled to the modulator. Frequency determining components are the tapped variable inductance, L11, and parallel capacitors C62, C63, C64, C65 and C93. The tuning drive mechanism is connected to the shaft of C62, the main tuning capacitor. Capacitor C65 is a compensating capacitor, providing negative temperature coefficient compensation. C93 is the fine-tuning panel control, an eccentric disc (rotor) which electrically loads and unloads a tab (stator) on the main tuning capacitor C62 for minute changes in frequency. Because C93 will rotate 360 degrees to avoid tuning error, the fine-tuning control should be used over only 180 degrees as marked on the panel. Inductor L11 and capacitor C63 are tracking adjustments for alignment purposes. Local oscillator output is fed to cathode follower, V10B, for isolation and impedance matching.

7. Crystal Filters

Two selectivity positions are available in selective frequency operation using crystal filters with center frequencies of 2.215 MHz, and bandwidths of 2500 cycles and 250 cycles. The output impedance of the cathode follower, V2, is about 4000 ohms, matching the input of the crystal filters. Wafers S3c and S3d switch the input and output of the desired filter, to feed (SEL 2500 ~, SEL 250 ~ and CAL 2) or by-pass (FLAT and CAL 1) the IF amplifier. The resistive T-pad network formed by resistors R38 through R43 provides a means of matching the filters to the IF amplifier, and of balancing the filter outputs, with R42, to provide signals of equal amplitude for the IF amplifier. Output of the T-pad is applied to the grid of V3.

8. IF Amplifier

The amplifier is comprised of two r-c coupled pentode stages, V3 and V4, which provide a combined gain of about 45 dB. A single tuned grid is used to decrease the number of tuned circuit elements susceptible to temperature gain

instability. CAL 2 gain control R55 provides a means of varying the IF gain through a range of at least 3 dBm either side of the nominal gain. Output of the IF amplifier is applied to the grid of V5, the first flat voltmeter stage, through S3b.

9. Flat Voltmeter Operation

Three r-c coupled pentode stages and an associated output meter constitute the wide band flat voltmeter section. This amplifier has a gain of about 35 dB, incorporating approximately 20 dB of feedback to provide gain stability. Output meter readings are stable within 0.1 dB for a line voltage change of ±10 per cent, and for variations in tube g_m up to 25 per cent.

10. Output from the last IF stage, V4, is carried through S3b (in CAL 2, SEL 2500~ and SEL 250 ~ positions) to the grid of V5, the input amplifier stage of the flat voltmeter. Coupling capacitor C36 is a relatively small value (1000 pF) and in conjunction with R62, provides a smooth fall-off in response below 1 kHz. High frequency fall-off is controlled by capacitors C43 and C35 with R71, R72 and R59. The signal is further amplified in V6, and coupled to V7. Output of the three-stage amplifier is applied to the full-wave silicon diode bridge. Output meter M1 is connected across the bridge, and dc current through the one milliampere movement is proportional to the average ac voltage applied to the bridge.

11. In the CAL 1 and FLAT positions of the FUNCTION selector switch S3, signals other than 2.215 MHz are applied to the flat voltmeter. In CAL 1, the 100 kHz signal from the injection oscillator is used to calibrate the voltmeter as a reference against which the gain through the input-mixer-IF section is set. When S3 is in FLAT position, signals from 1 kHz to 620 kHz may be fed to the voltmeter. In CAL 2, SEL 2500 ~ and SEL 250 ~, the input signal is first applied to the mixer IF section, so that the signal reaching the flat voltmeter is 2.215 MHz, the IF otuput frequency.

12. Audio Amplifier

A portion of the output of the last flat voltmeter stage is coupled from a plate resistive dividing network to the audio amplifier stage. The audio component of the signal thus applied is detected by a simple crystal diode demodulator comprised of CR3, R129 or R116 and R117, L6, R74 and C47. The GAIN control, R82, determines the input level. The amplifier itself is a two-stage, twin-triode, r-c coupled circuit, the output of which is terminated at the panel mounted PHONES jack.

13. Injection Oscillator

To provide a self-calibration capability, Model 125B includes an internally mounted 100 kHz signal source which is applied in CAL 1 position of the function selector switch through the input filter and attenuator to the flat voltmeter, and in

CAL 2, to the mixer IF section. The temperature compensated 100 kHz oscillator is a modified crystal-controlled Pierce circuit which generates a signal of constant amplitude. Frequency accuracy is 0.02 per cent over the specified temperature range. This signal, in addition to being used to calibrate flat voltmeter and mixer IF levels, is also used for checking oscillator tracking and tuning dial accuracy using the high order harmonics generated at 200, 300, 400, 500 and 600 kHz as reference signals. Output level is controlled with screwdriver adjusted potentiometer, R87.

14. Power Supply

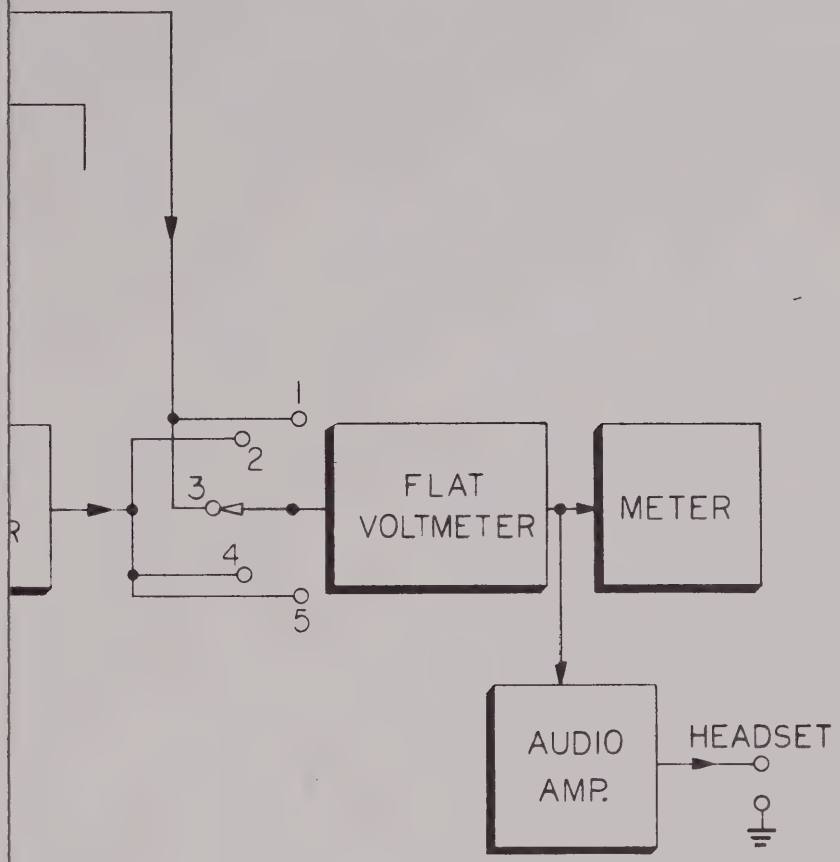
The power supply for Model 125B is comprised of a full-wave silicon diode bridge rectifier, a series regulator, V11, and a twin triode cascade amplifier, V12. Voltage reference tube, V13, holds the grid of V12B at a constant value, thus a decrease in output voltage allows V12B to conduct more heavily because of the apparent, or relative, increase in grid voltage. The plate of V12B then becomes more negative because of the increased drop across R110, and the grid of V12A becomes more negative, decreasing the current through that stage, and increasing its plate voltage. Being directly connected to the plate of V12A, the grid of V11 will become more positive. The resulting decrease in voltage dropped across V11 will restore the original output voltage. DC drift due to the effect of filament voltage changes in V13 is cancelled by differential action between the two sections of V12. Voltage adjustment potentiometer R113 establishes the operating level of the series regulator, and consequently the output voltage. Supply voltage is maintained at 225 volts, with regulation better than 0.25 per cent over a line voltage variation of 105 to 125 volts. Ripple amplitude is less than one millivolt. Input transient protection is provided with an r-c bridging network in the primary of T4.

15. Model 125C-CR

For measurement of single-sideband signals, the manufacturer has provided an instrument variation designated Model 125B-CR. This model includes in its circuitry, two crystal-controlled carrier reinsertion oscillators and a cathode follower. One triode oscillator, for lower sideband reception, operates at 1.5 kHz below the IF frequency. For upper sideband reception, the second oscillator operates at 1.5 kHz above the IF frequency. One of these two signals is applied as required through the cathode-follower stage to the diode demodulator at the input of the audio amplifier where it is combined with the carrier-suppressed sideband signal from the output of the flat amplifier. The reinserted carrier from the internal oscillator provides an rf base against which sideband signals beat, forming a combined signal which is reduced to its audio component at the demodulator. LS-AM-US switch, S5, selects the proper oscillator, and applies plate voltage for its operation. All three triode stages of the circuit are combined in a single envelope, V14.

16. Model 125B-Y

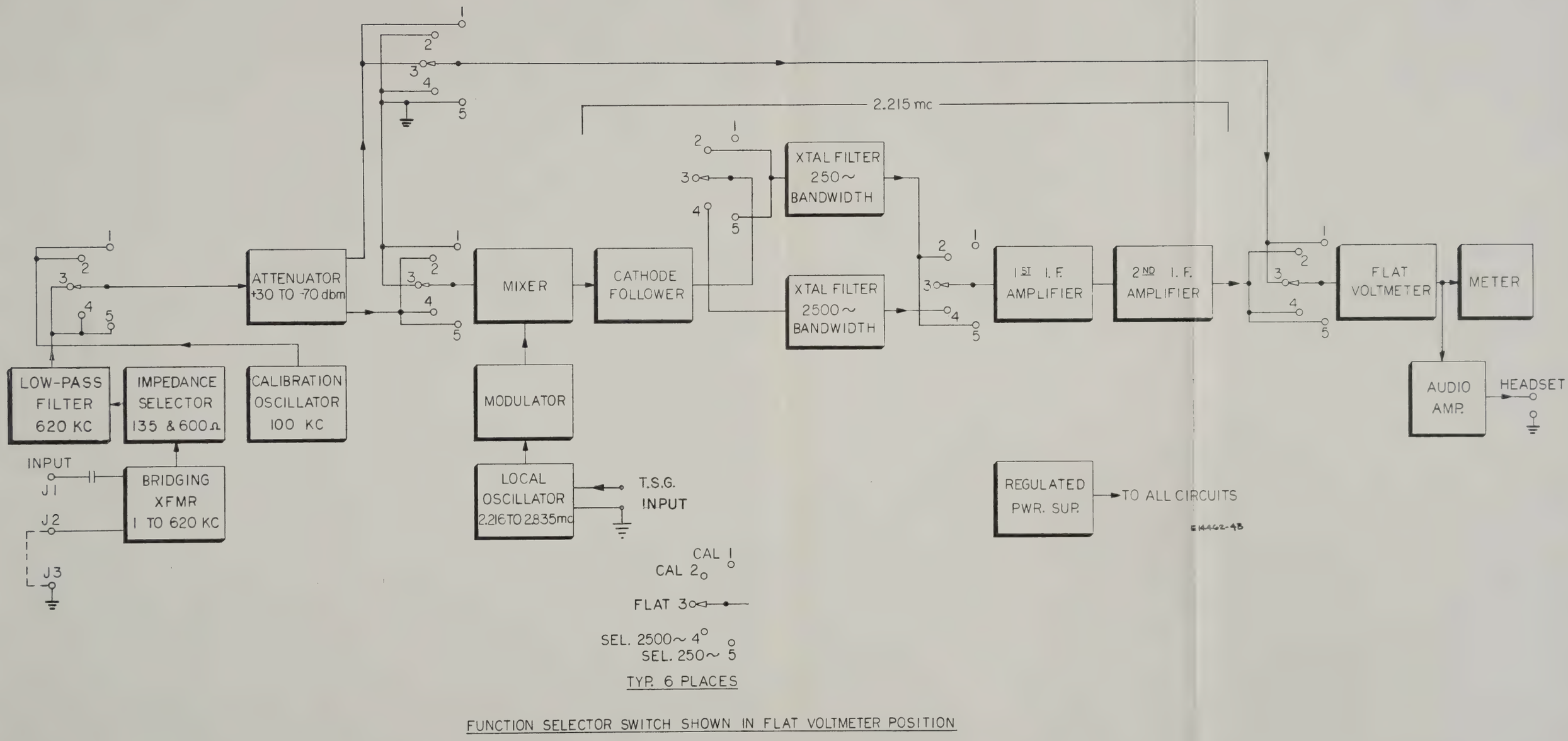
Basic operation of Model 125B-Y is identical to that of the standard Model 125B. The input selector S1, however, has been expanded in the number of selectable inputs made available through front-panel switching, to accommodate connection to long-line telephone systems. A 20-pin connector is mounted on the front panel, as shown in Figure 1-2, through which permanent or semi-permanent installation of input information may be made.



RCUITS

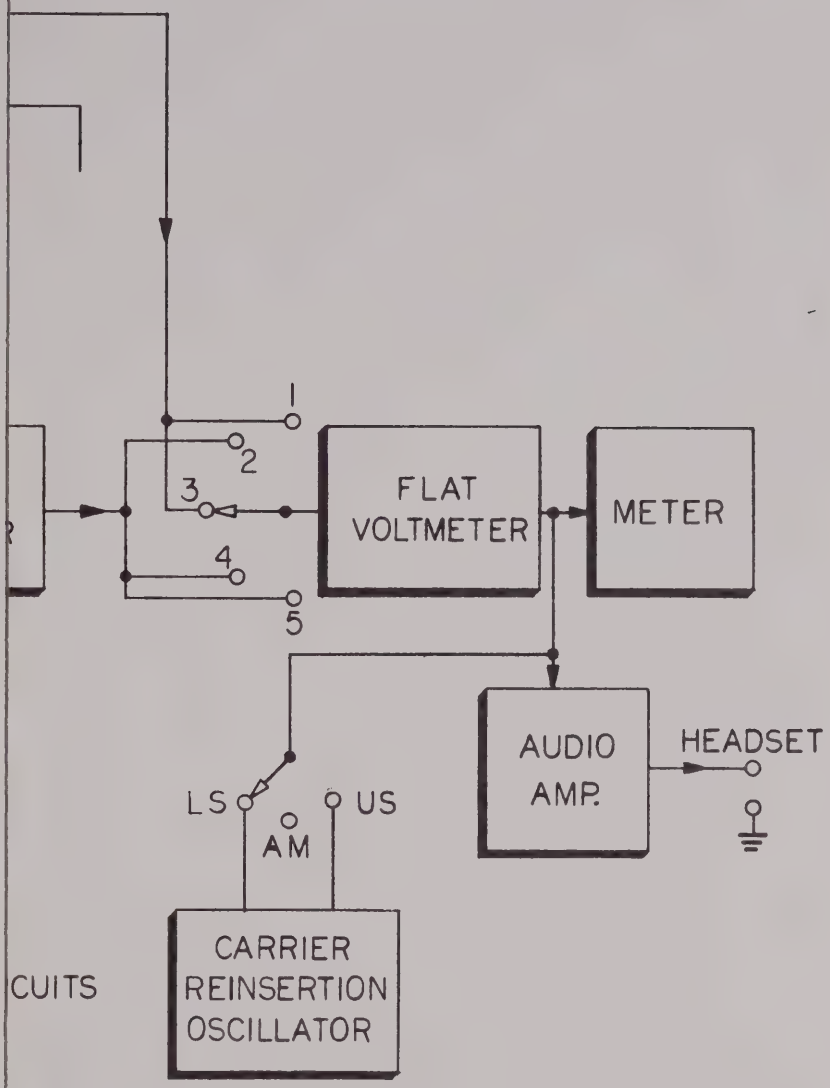
14462-4B

RE 2-1 Model 125B Function Block Diagram

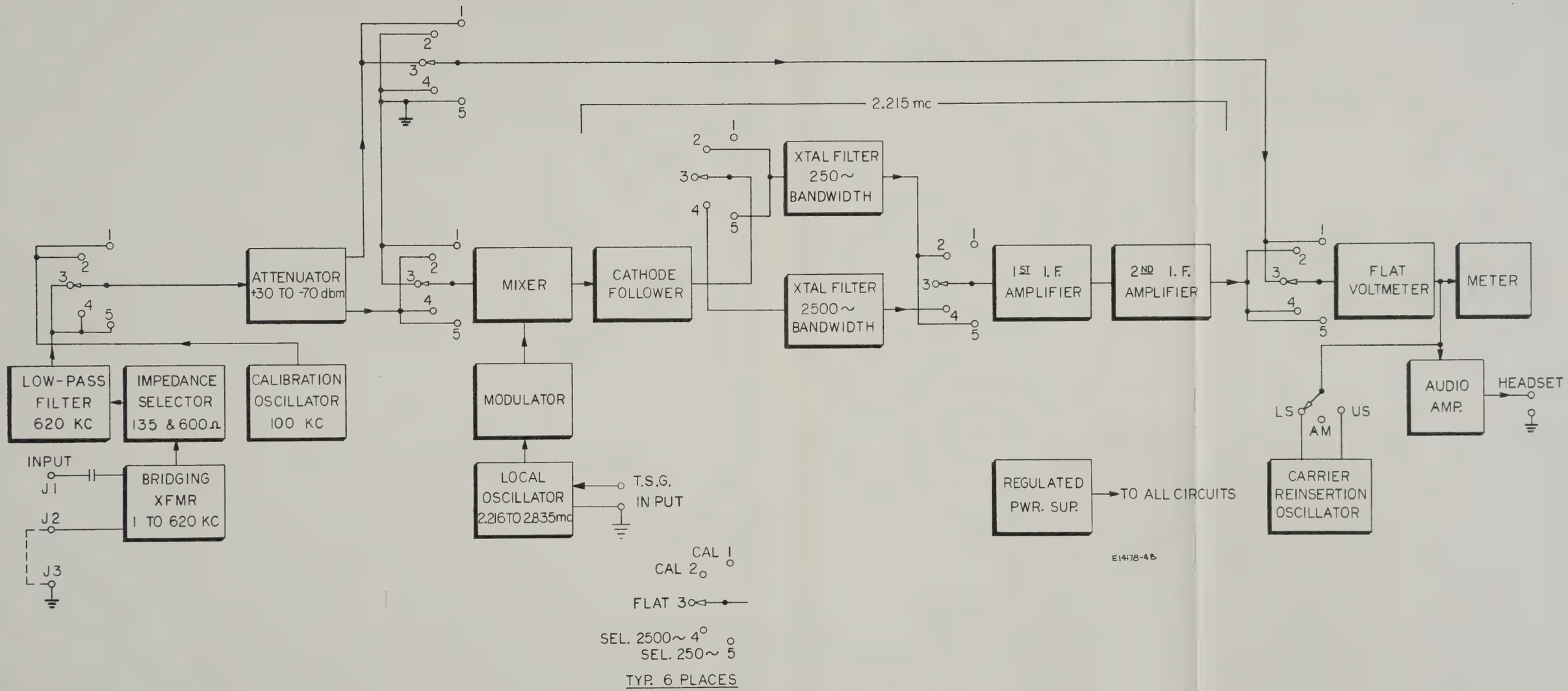


FUNCTION SELECTOR SWITCH SHOWN IN FLAT VOLTMETER POSITION

FIGURE 2-1 Model 125B Function Block Diagram

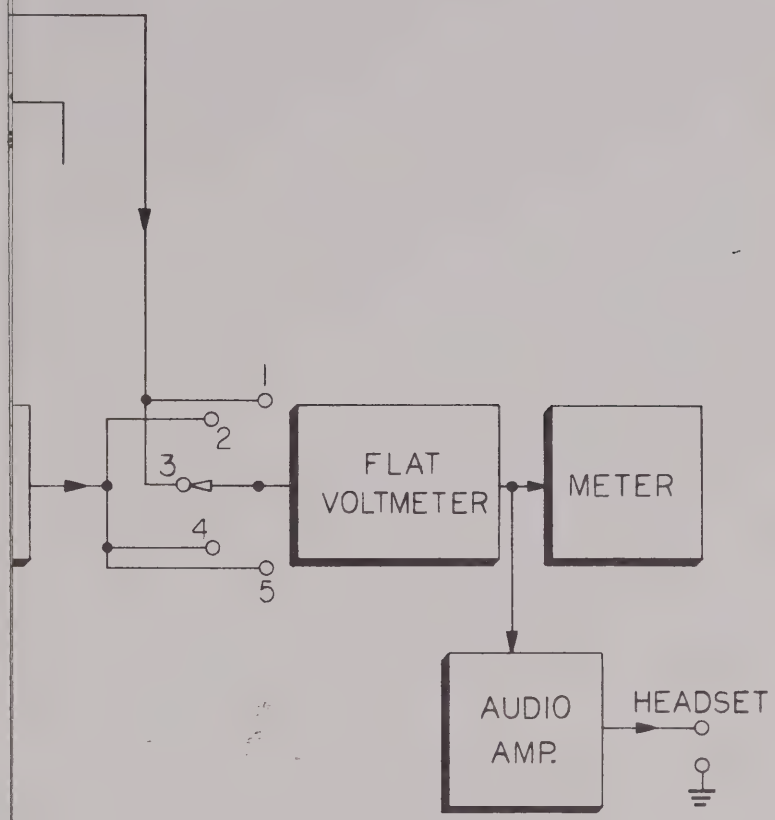


Model 125B-CR Functional Block Diagram



FUNCTION SELECTOR SWITCH SHOWN IN FLAT VOLTMETER POSITION

Figure 2-2. Model 125B-CR Functional Block Diagram



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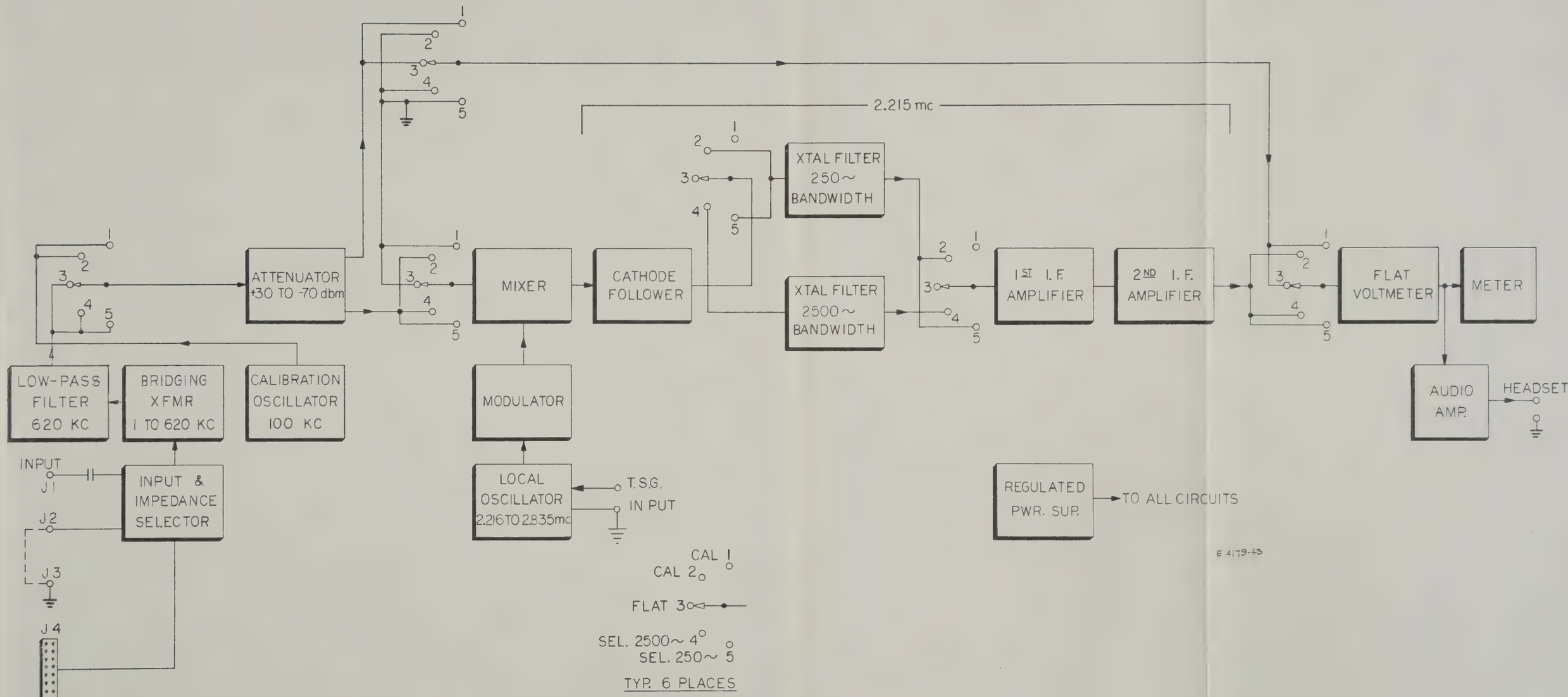
el 125B-Y Functional Block Diagram



FUNCTION SELECTOR SWITCH SHOWN IN FLAT VOLTMETER POSITION

Figure 2-3. Model 125B-Y Functional Block Diagram

SECTION III

MAINTENANCE

A. CALIBRATION

1. General

Calibration procedures described in this section may be conducted independently. For complete calibration to manufacturer's recommended specifications, each unit of the voltmeter should be calibrated in the sequence presented in this section. Adjustment difficulties may indicate circuit malfunction. Refer to paragraph B. for trouble-shooting information.

2. Power Supply Adjustment

Using a dc vacuum tube voltmeter, perform the following steps:

a. Connect the dc VTVM between TP1 and chassis ground.

b. Adjust R113 for an output voltage of 225 volts.

c. Vary line voltage from 105 to 125 volts; there should be no change in output voltage in excess of 0.25 percent.

d. Using an ac VTVM and short, shielded connections, observe ripple and noise components; they should not exceed 1.0 millivolt over a line voltage variation of 105 to 125 volts. Whenever noise and ripple are less than 1.0 millivolt combined, regulation will be within specification.

3. Input Circuit

Check the input circuit and attenuator in the following manner.

(1) Connect an rf signal generator providing a 100 kHz, 0 dB signal to the voltmeter input terminals.

(2) Connect binding posts for balanced input.

(3) Set ATTENUATOR at -70 dB.

(4) Set LINE IMPEDANCE at 600 Ω BRG.

(5) Set FUNCTION at SEL 2500 ~ .

(6) Remove oscillator tube, V10.

(7) With signal generator tuned to 100 kHz at 0 dB level, measure from output of ATTENUATOR switch, S2, to ground using an ac VTVM. Voltage should be -16 dBm.

(8) Set LINE IMPEDANCE to 135Ω BRG: ac voltage should be -10 dBm.

(9) Change input binding posts from balanced to unbalanced input.

(10) Repeat steps (1) through (8).

(11) Replace oscillator tube V10.

4. Flat Voltmeter Adjustment

Allow fifteen (15) minutes for warmup. When circuits have stabilized, proceed using the method described below:

a. Set LINE IMPEDANCE at 600Ω BRG.

b. Set FUNCTION to FLAT.

c. Set ATTENUATOR at 0 dB.

d. Connect a low distortion rf signal generator to the input binding posts.

e. Calibrate signal generator for 0 dB output at 100 kHz.

f. Adjust amplifier gain at R71 for an output meter reading of 0 dBm.

g. Tune signal generator successively to 1 kHz, 3 kHz, 10 kHz, 50 kHz, 200 kHz, 300 kHz, 400 kHz, 500 kHz and 620 kHz at 0 dB level, and record output meter reading for each frequency. Variation should be less than 0.5 dB from 3 kHz to 620 kHz and less than 0.7 dB from 1 kHz to 620 kHz.

h. Repeat step (g) with LINE IMPEDANCE in 135Ω BRG position.

5. Output meter linearity determination requires an attenuator of 600 ohms impedance and an rf signal generator. Procedure is indicated below:

a. Apply a 100 kHz, 0 dB signal to voltmeter binding posts through external attenuator.

b. Set external attenuator for straight-through operation, i.e., no attenuation.

c. Set voltmeter ATTENUATOR at 0 dB. Output meter should read 0 dB.

d. Attenuate the input signal in 1 dB steps to -10 dB, recording the output meter reading at each step. All readings should be within ±0.2 dBm of the actual attenuated input level.

e. Increase attenuation to -15 dB. Output meter should read within ±0.5 dBm.

f. Increase attenuation to -20 dB. Output meter should read within ±1.0 dBm.

6. Mixer IF Preliminary Adjustment

Initial adjustment procedures for the mixer IF section are listed below:

a. Set FUNCTION to SEL 2500 ~ .

b. Set ATTENUATOR at 0 dB.

c. Set CAL 2 fully clockwise.

d. Connect a jumper from binding post J1 to the output arm of S2c.

e. Feed a 2.215 MHz signal from an external RF source to the input of the voltemter at a level which will give half-scale deflection of the output meter.

f. Tune L3, L4 and L5 progressively for maximum meter indication. Reduce input signal as required to maintain half-scale indication.

7. Local Oscillator Adjustment

following a fifteen-minute warm-up period, track the local oscillator in the following manner:

a. Set FUNCTION to SEL 250 ~ .

b. Set ATTENUATOR at 0 dB.

c. Place 3 kHz tuning dial mark on indicator hairline.

d. Set FINE tuning control at midpoint.

e. At 0 dB level, feed 3 kHz signal to voltmeter, and tune L11 for maximum meter deflection.

f. At 0 dB level, feed 620 kHz signal to voltmeter, and tune C63 for maximum meter deflection.

g. Repeat steps e. and f. as needed to set upper and lower frequency extremes.

h. Should the 150 kHz to 450 kHz segment not track within 0.5 kHz, bend the serrated plates of C62 to improve tracking to specified tolerance (0.5 kHz).

8. Modulator Adjustment

Balanced modulator adjustment requires an oscilloscope; procedure is described below:

a. Turn instrument on; allow fifteen minutes for circuit to stabilize.

b. Set FUNCTION to SEL 2500 ~ .

c. Remove modulator cover, and with the oscilloscope read the rf envelope amplitude alternately at C66 and C67, adjusting R100 until the two amplitudes are equal.

d. Replace the modulator cover, set the frequency dial at 3 kHz, leaving FUNCTION set at SEL 2500 ~ .

e. Tune C66, C67, C68, and C69 for minimum signal indication, correcting each interaction until the residual output meter reading is as low as obtainable. Spurious harmonic generation should be at least 63 dB down. Tune the frequency dial to 5 kHz; residual reading should not exceed -20 dB. A non-metallic screwdriver must be used in this procedure.

NOTE: The meter reading during this operation is not affected by the attenuator. Detected voltage is due to local oscillator feed-through.

9. Injection Oscillator Output

No provision is made for adjustment of the injection oscillator frequency. It may be desired, however, to check the frequency to see that it remains within the specified tolerance. Measured frequency at TP9, using an accurate counter or frequency meter, should be 100 kHz ±0.02 percent.

9. The injection oscillator rf output level is set in the following manner after checking the Flat Voltmeter adjustment (paragraph 3).

a. Set FUNCTION to CAL 1.

b. Set ATTENUATOR to 0 dB.

c. Adjust R87 for an output meter reading of 0 dBm.

10. Mixer IF Final Tuning

Final adjustment of the mixer IF section is described below:

a. Set FUNCTION to SEL 250 ~ .

b. Set ATTENUATOR to 0 dB.

c. Set CAL 2 at mid-position.

d. Feed a 100 kHz signal at 0 dB level to the input of the voltmeter.

e. Tune voltmeter to the input signal, and peak output meter indication with the FINE tuning control.

f. Tune L3, L4 and L5 for maximum output meter deflection.

11. CAL 2 Range

With a 0 dB input signal and CAL 2 control set fully clockwise, output meter should read at least +3 dB. Turning the CAL 2 control fully counterclockwise should bring the reading down at least -3 dB.

12. 2500 Cycle Bandwidth Check

Although the 2500 ~ and 250 ~ crystal filters are not adjustable, a complete calibration procedure should include a check of filter response. A method of determining bandwidth is described below:

a. Set ATTENUATOR to 0 dB.

b. Set FUNCTION to SEL 2500 ~ .

c. Apply 0 dB signal at 100 kHz to input of voltmeter.

d. Tune voltmeter to incoming signal, and adjust CAL 2 for 0 dB output meter indication.

e. Increase input signal frequency from 100 kHz until output meter indication decreases 3.0 dB. Record frequency.

f. Decrease input frequency from 100 kHz until output meter indication decreases 3.0 dB. Record frequency. The sum of the differences in frequency obtained in e. and f. is the nose width of the response curve at 2500 Hz and should be 2500 ±200 Hz. Using a similar technique the 60 dB bandwidth should be less than 14 kHz.

13. 250 Cycle Bandwidth Check

Using the method described in paragraph 11.-12., bandwidth at the 3 dB points of the 250 cycle curve should be 250 ±50 Hz and the 60 dB points less than 1400 cycles.

14. Filter Output Level Matching

To ensure proper input level to the IF strip, the crystal filter outputs are balanced in the following manner:

a. Set FUNCTION to SEL 2500 ~ .

b. Feed a 100 kHz, 0 dB signal to voltmeter input binding post. Tune carefully for maximum output meter deflection. Record meter reading.

c. Set FUNCTION to SEL 250 ~ .

d. If reading varies, adjust R42 so that output indications are equal at 2500 cycles and at 250 cycles.

15. Attenuator Step Check

The attenuator is checked using a signal generator, an external decade attenuator and an ac VTVM accurate to 1 percent. Procedure follows:

a. Set ATTENUATOR at +20 dB.

b. Set FUNCTION at SEL 250 ~ .

c. Set LINE IMPEDANCE at 600Ω BRG.

d. Apply a 20 kHz signal at 20 dB level to voltmeter; binding posts in unbalanced connection.

e. Switch ATTENUATOR to +30 dB. Output meter should read -10 dB.

f. Attenuate input signal 10 dB using decade attenuator, and switch voltmeter ATTENUATOR to +10 dB. Output meter should read 0 dB ±0.2 dB.

g. Attenuate input signal in 10 dB steps while increasing voltmeter sensitivity in 10 dB steps to -70 dB. Output meter should remain accurate to ±0.2 dB.

h. Repeat steps a. through g. using a 620 kHz signal.

16. Selective Voltmeter Response

Using a signal generator, and an ac VTVM, determine voltmeter linearity in selective operation using the following procedure:

a. Set FUNCTION to SEL 250 ~ .

b. Set ATTENUATOR at 0 dB.

c. Apply 100 kHz signal to voltmeter at 0 dB.

d. Tune and peak voltmeter to incoming signal.

e. Adjust CAL 2 for 0 dB on output meter.

f. At 3 kHz, 10 kHz, 50 kHz, 200 kHz, 300 kHz, 400 kHz, 500 kHz, and 620 kHz, all at 0 dB input level, record output meter readings. All readings should be 0 dB, ±0.5 dB.

17. Intermodulation Measurement

Frequencies of 62.5 kHz and 100 kHz at 0 dB level are fed to the voltmeter input through a mixing pad to determine intermodulation characteristics of the voltmeter. Proceed in the following manner:

a. Set FUNCTION at SEL 2500 ~ .

b. Set ATTENUATOR at 0 dB.

c. Apply mixed frequencies to voltmeter.

d. Adjust CAL 2 for 0 dB output meter indication. Do not disturb CAL 2 or input signal generators for remainder of the test.

e. Tune the voltmeter to the following frequencies; with ATTENUATOR at -60 dB:

172.5 kHz	245.0 kHz
27.5 kHz	127.5 kHz
45.0 kHz	272.5 kHz

These are all sums or differences of the two input frequencies, and should measure less than -60 dB on the output meter.

18. Noise Level

Normal noise in the instrument in SEL 2500 ~ position is about -20 dB with CAL 2 fully clockwise. Most circuit noise is generated in the mixer stage and cannot be eliminated without deteriorating mixer performance. Noise may be read directly on the output meter.

B. MAINTENANCE

1. Troubleshooting

Malfunctions can usually be determined rapidly using a sectionalizing system in conjunction with references to the equipment block diagram. First determine the correct operation of the power supply, checking the output voltage and ripple content. Excessive ripple and noise are due to power supply or decoupling network failure. Second, determine that the flat voltmeter operates correctly, since all other circuitry depends on its operation. Then approach the injection oscillator, mixer, IF, and local oscillator sections. Occasionally coupling or decoupling capacitors leak only under conditions of high ambient temperature, and removal of the equipment from its cabinet may cause the fault to disappear. Microphonics are usually caused by poor switch contacts, loose solder joints or defective tubes. For resistance and voltage measurement, refer to Tables 3-2 and 3-3. For troubleshooting tips see Table 3-1.

2. Care should be exercised in working on printed circuit boards. Remember that excessive heat will destroy the board and its circuitry. Use only enough heat, using some form of heat sink, to remove the component. Remount all components close to the board to avoid mechanical strain on leads.

TABLE 3-1. TROUBLESHOOTING TIPS

TROUBLE	PROBABLE CAUSE	REMEDY
No Power, panel Switch "ON"	1. No line voltage. 2. Defective power cord. 3. Fuse F1 blown	1. Check line voltage. 2. Replace cord. 3. Determine cause, replace fuse.
Fuse F1 Blown	1. Burned out diode in power supply. 2. Short in dc supply. 3. Short in filament supply.	1. Replace diodes. 2. Determine cause, repair. 3. Determine cause, repair.
No meter reading in CAL 1 position	1. Injection oscillator failure. 2. Flat amplifier failure. 3. Power supply failure 4. Function switch failure. 5. Wiring failure	1. Check V9, Y1, replace if necessary. 2. Check V5, V6,V7, CR1, CR2, replace if necessary. 3. Check V11,V12, replace if necessary. 4. Check wafers contacts. Repair or replace. 5. Check osc. shielded output lead for short or open circuit.
No meter reading in CAL 2 position (CAL 1 functions properly) or No meter reading in SEL 2500 ~ and SEL 250 ~	1. Local oscillator failure. 2. Mixer failure. 3. IF failure. 4. Function switch failure.	1. Check V10, CR4, CR5, CR6, replace if necessary. 2. Check V1, V2, replace if necessary. 3. Check V3, V4, replace if necessary. 4. Check wafers contacts, repair or replace.
Unable to set 0 to dB in CAL 2 position	1. Local oscillator output low. 2. Detuned circuit in mixer or IF stages. 3. Low overall gain. 4. Injection oscillator output low.	1. Check CR4, CR5, CR6 replace if necessary. 2. Retune L3, L4, L5. 3. Check V1 through V7 and replace if necessary. 4. Check V9, Y1, replace if necessary.

TABLE 3-1. TROUBLESHOOTING TIPS (Continued)

TROUBLE	PROBABLE CAUSE	REMEDY
Excessive "no signal" meter indication	1. Faulty modulator. 2. Detuned modulator. 3. Loose oscillator or modulator cover.	1. Check, replace CR4, CR5, CR6 if required (CR4, CR5 are a matched pair replacement). 2. Retune modulator. 3. Tighten cover.
No linear output meter response	1. Defective meter diodes. 2. Defective meter.	1. Check or replace CR1, CR2. 2. Check or replace meter.
Unable to tune incoming signal (instrument operates correctly in CAL 2)	1. Open input circuit. 2. Defective bridging transformer. 3. Faulty LINE IMPEDANCE selector. 4. Faulty FUNCTION selector.	1. Check binding post and associated wiring. 2. Check or replace transformer. 3. Check contacts, repair or replace. 4. Check contacts, repair or replace.
Frequency Tuning Error	1. Local oscillator not tracking properly. 2. Loose local oscillator drum or variable capacitor. 3. Local oscillator shift in frequency range.	1. Check and adjust per paragraph A.6. 2. Check and repair. 3. Defective L11,C63,C64, C65.
Unequal readings in SEL 2500 ~ and SEL 250 ~ and CAL 2 (after proper calibration)	1. Filter output levels not matched.	1. Adjust R42.
Poor regulation of power supply output	1. Line voltage too high or too low. 2. Defective tubes. 3. Open or leaky capacitor.	1. Check line voltage. 2. Check or replace V11, V12, V13. 3. Check or replace C80, C83, C82.

TABLE 3-1. TROUBLESHOOTING TIPS (Continued)

TROUBEL	PROBABLE CAUSE	REMEDY
Power supply delivers excessive dc output voltage.	1. Regulator V13 2. Amplifier V12	1. Check or replace. 2. Check or replace.
Power supply delivers too low a dc output voltage.	1. Series tube V11. 2. Diodes CR7 to CR10.	1. Check or replace. 2. Check or replace.
No audio output	1. Audio amplifier V8. 2. Audio detector CR3. 3. Open audio control. 4. Defective phone jack.	1. Check or replace V8. 2. Check or replace CR3. 3. Check or replace R82 4. Check or replace J4.

TABLE 3-2. RESISTANCE VALUES*

TEST POINT		RESISTANCE IN OHMS
Power Supply		
T3	1 and 2	Inf.
T3	7 and 8	Inf.
T3	3 and 4	30K
T3	5	0.5 ohm Max.
V11	Pin 1	560K
V11	Pin 3 (TP1)	30K
V12	Pin 1	560K
V12	Pin 2	560K
V12	Pin 3	18K
V12	Pin 6	560K
V12	Pin 7	95K
V12	Pin 8	22K
V13	Pins 1, 5	95K
V13	Pins 2,4,7	0

TEST POINT		RESISTANCE IN OHMS
Mixer		
TP4		30K
TP7		4.7K
TP8		Inf.
Local Oscillator		
V10	Pin 1	80K
V10	Pin 2	100K
V10	Pin 3	.3
V10	Pin 6	30K
V10	Pin 7	1 Meg.
V10	Pin 8	1K
C57	(TP29)	30K
T2	1	4.6
T2	3	0

*Measurements made with 20K/ohms/voltmeter.

TABLE 3-2. RESISTANCE VALUES (Continued) *

TEST POINT		RESISTANCE ON OHMS
Modulator		
TP31		4700
T2	1	4.6
TP2	3 and 5	0
TP2	4	45
T2	6	45

TEST POINT	RESISTANCE IN OHMS
IF Amplifier	
TP13	2.2K
TP14	30K Approx.
TP15	.11
TP16	.11
TP18	0 to 2.5K
TP19	30K Approx.
TP20	.11

TABLE 3-3. VOLTAGE REFERENCE CHART*

TP NO. OR LOCATION	VOLTAGE
Power Supply	
TP1	225V dc +.25% (105 to 125V ac)
TP2 & TP3	6.3V ac across terminals
V11 Pin 5	350V dc
V12 Pin 1	219V dc
V12 Pins 2, 6	130V dc
V12 Pin 3	132V dc
V12 Pin 8	86V dc
V13 Pins 1, 5	87V dc
IF Amplifier	
TP13	Variable rms
TP14	225V dc
TP16	Variable rms
TP19	225V dc
TP20	Variable rms
V3 Pin 2	.5V dc
V3 Pin 5	74V dc
V3 Pin 6	40V dc
V4 Pin 2	9.1V dc R55 at
V4 Pin 5	156V dc max.re-
V4 Pin 6	120V dc sistance

TP NO. OR LOCATION	VOLTAGE
Mixer-Cathode Follower	
TP4	225V dc
TP5	6.3V ac
TP6	Variable rms
TP7	34V dc
V1 Pin 5	198V dc
V1 Pin 6	145V dc
V2 Pin 2	2.4V dc
V2 Pins 5,6 & 7	47V dc
Flat Amplifier	
V5 Pins 2,7	0.6V dc
V5 Pin 5	131V dc
V5 Pin 6	62V dc
V6 Pins 2,7	1V dc
V6 Pin 5	200V dc
V6 Pin 6	100V dc
V7 Pins 2,7	1.0V dc
V7 Pin 5	155V dc
V7 Pin 6	100V dc
TP25, TP26	154V dc

*Measurements made with 20K/ohms/voltmeter.

TABLE 3-3. VOLTAGE REFERENCE CHART*
(Continued)

TP NO. OR LOCATION	VOLTAGE
Injection Oscillator	
TP10	225V dc
V9 Pin 3	.9V dc
V9 Pin 6	62V dc
V9 Pin 8	12V dc

*Measurements made with 20K/ohms/voltmeter.

CALIBRATION AND MAINTENANCE ADDENDUM

CARRIER REINSERTION OSCILLATOR ADJUSTMENT (Model 125B-CR only)

Allow fifteen (15) minutes for warmup. When circuits have stabilized, proceed as follows:

1. Set FUNCTION switch to SEL 2500 ~ .
2. Set ATTENUATOR to 0.
3. Set LINE IMPEDANCE to 600Ω BRG.
4. Set AUDIO selector switch to AM.
5. Plug headset into PHONES jack.
6. Connect a low distortion rf signal generator to input binding posts.
7. Set signal generator for 0 dB output at 100 kHz, unmodulated.
8. Adjust frequency dial of voltmeter to incoming frequency.
9. Adjust CAL 2 for a 0 dB meter reading.
10. Detune voltmeter to lower frequency side of signal to a nominal meter reading of -10 dB.
11. Switch AUDIO selector to LS and adjust C101 for zero beat, as heard in headset. (If zero beat cannot be obtained at -10 dB, any point between -12 and -8 dB is acceptable.)
12. Detune voltmeter to higher frequency side of signal for a nominal meter reading of -10 dB.
13. Switch AUDIO selector switch to US and adjust C102 for zero beat as in step (11).

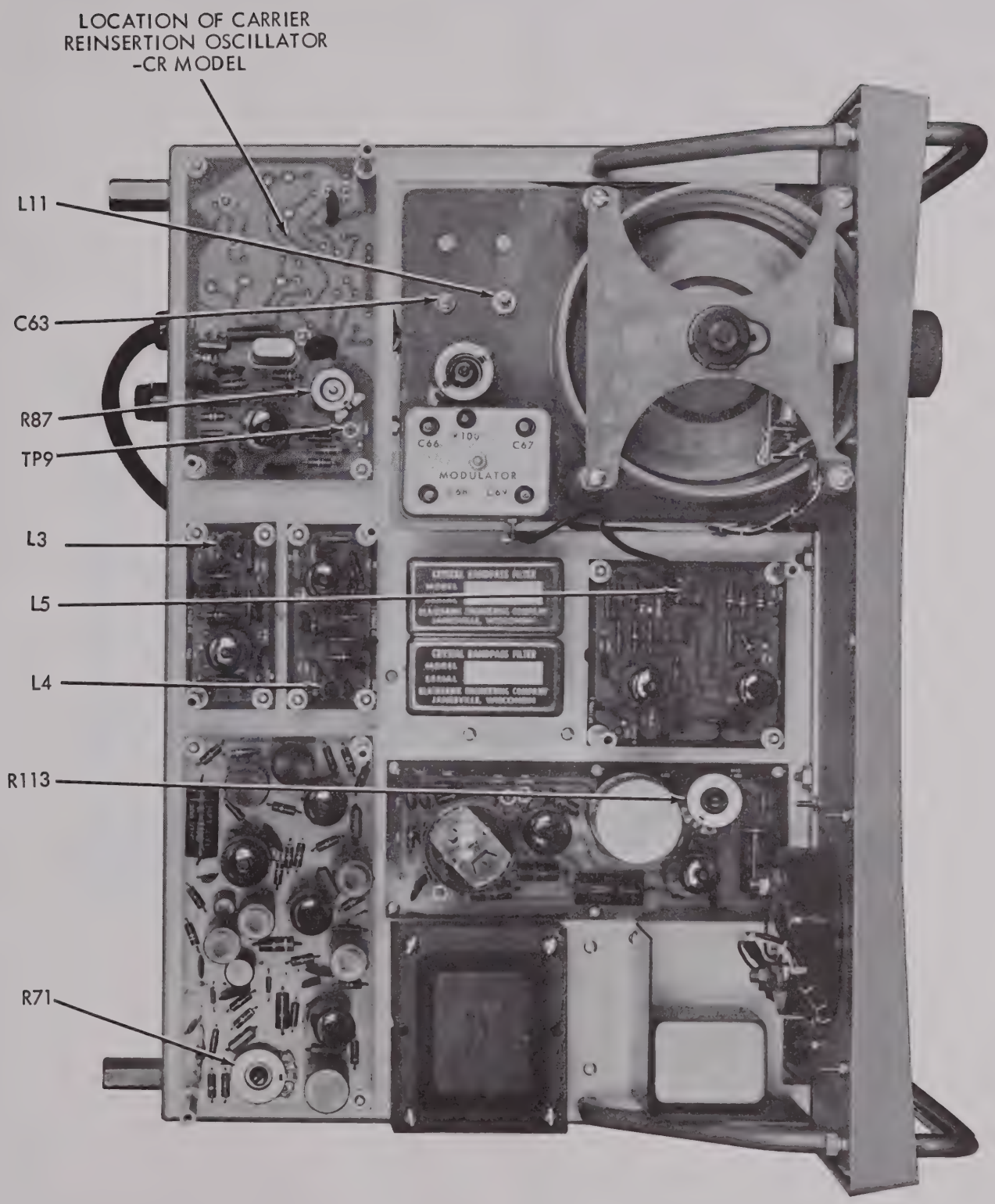


FIGURE 3-1. Model 125B, Top View

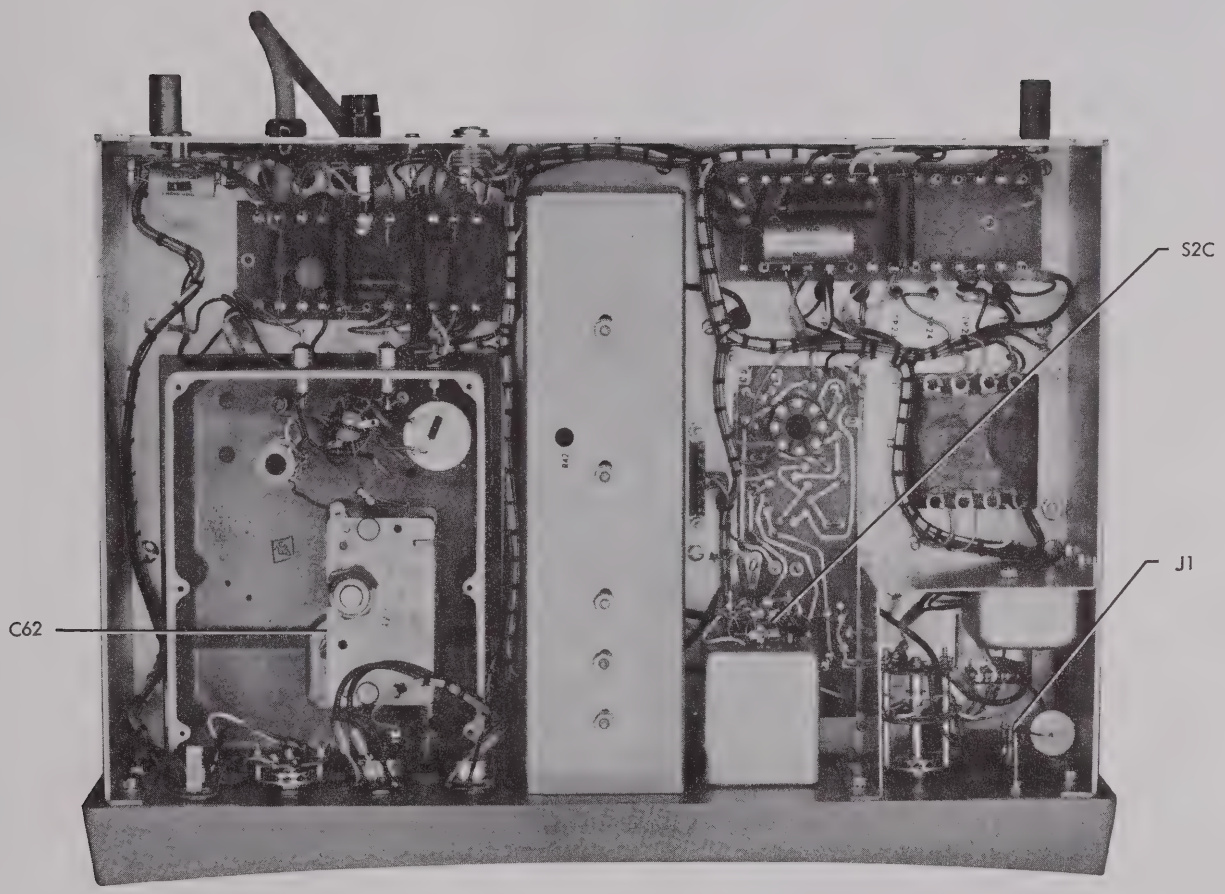
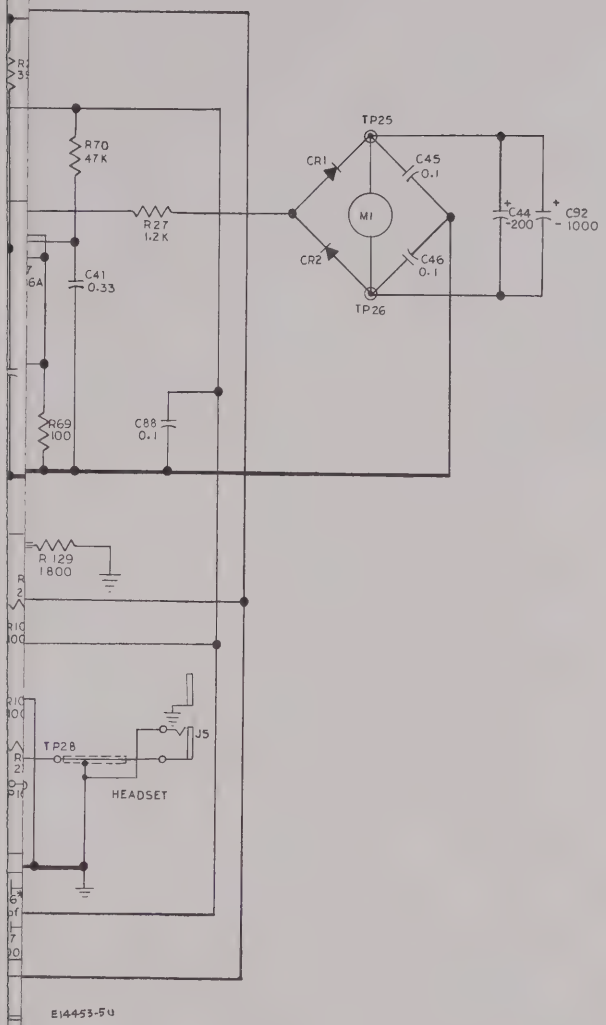


FIGURE 3-2. Model 125B, Bottom View

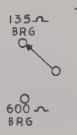


NOTE:
SYMBOL ○ DESIGNATES FRONT PANEL CONTROL
SYMBOL ⊘ DESIGNATES SCREWDRIVER CONTROL
RESISTOR IN OHMS, (K=1000)(M=1000000)
CAPACITORS IN MICROFARADS (pf=10^{-12} farad)
LAST SYMBOL USED

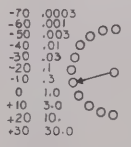
R=129	J=5
C=111	T=3
S=4	CR=10
L=18	Y=1
V=13	TP=31

*TEMPERATURE COMPENSATION

S1 TYPICAL



S2 TYPICAL



S3 TYPICAL

Schematic Diagram

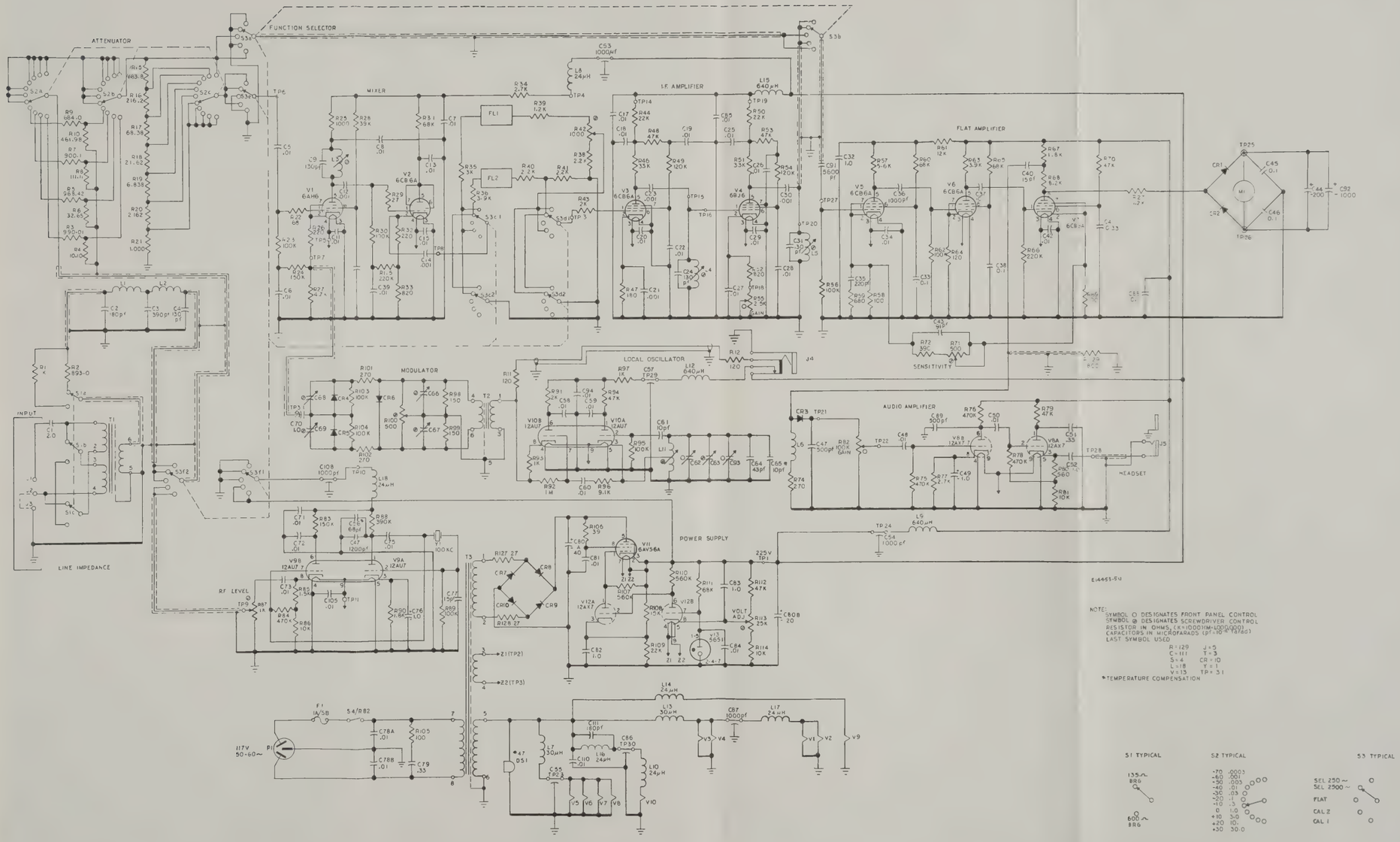
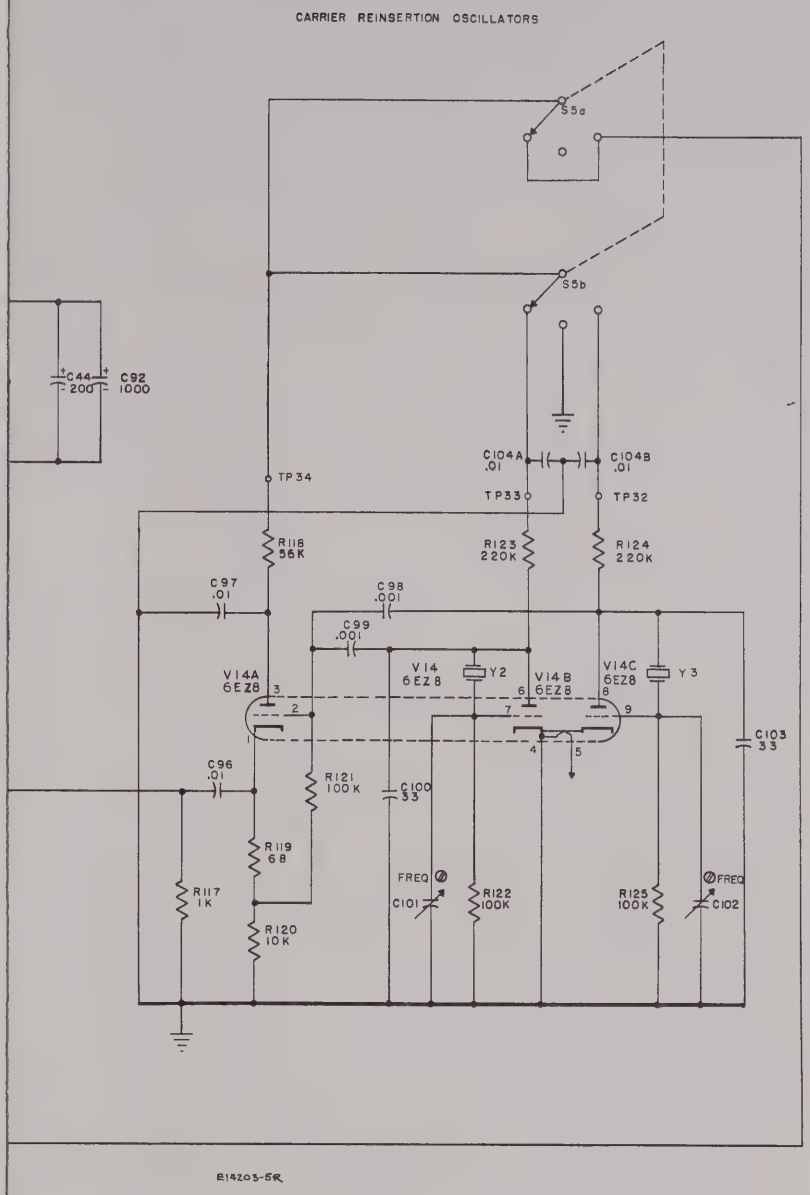


Figure 3-3. Model 125B Schematic Diagram



CAL S5 TYPICAL

125B-CR Schematic Diagram

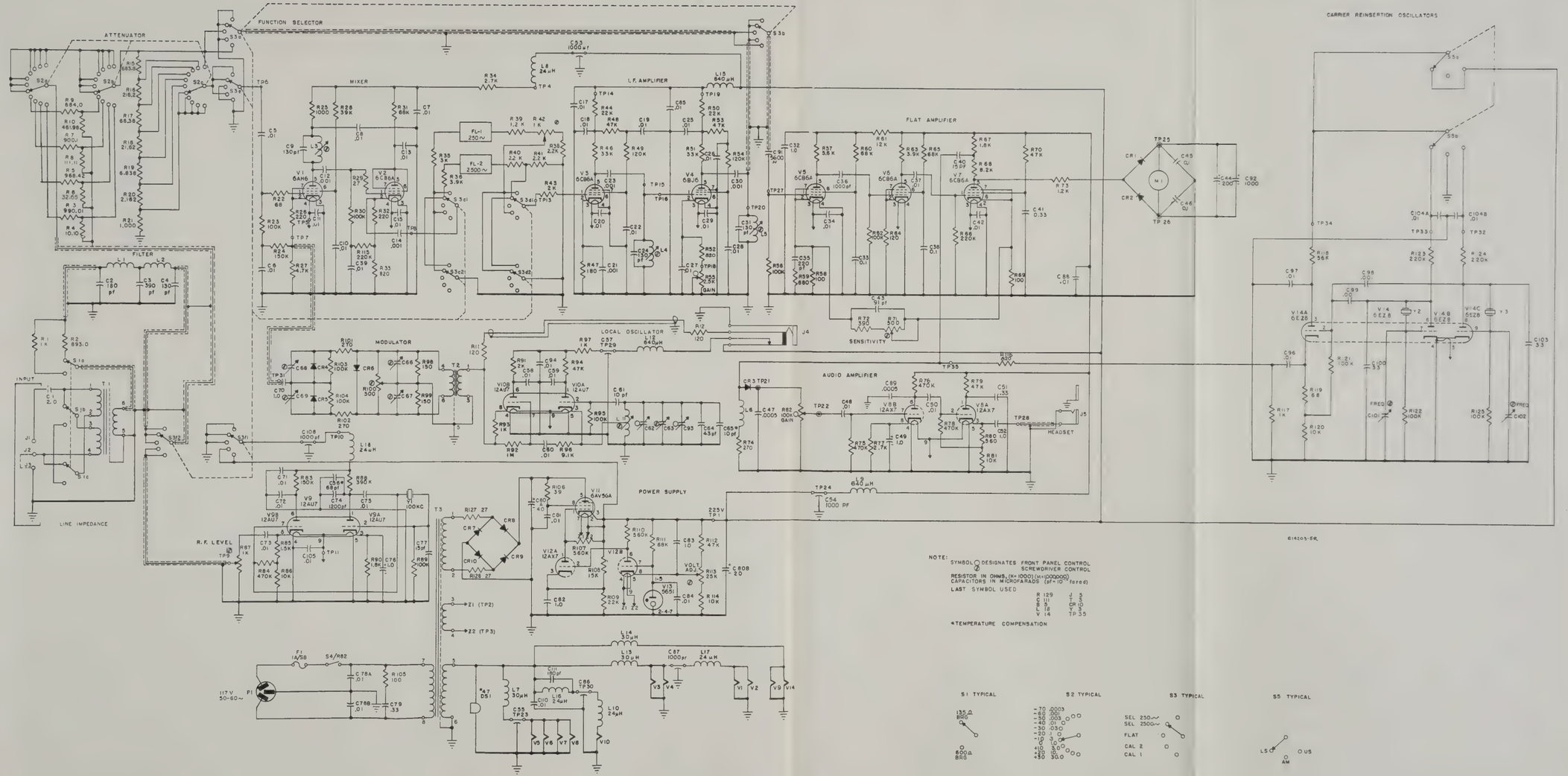
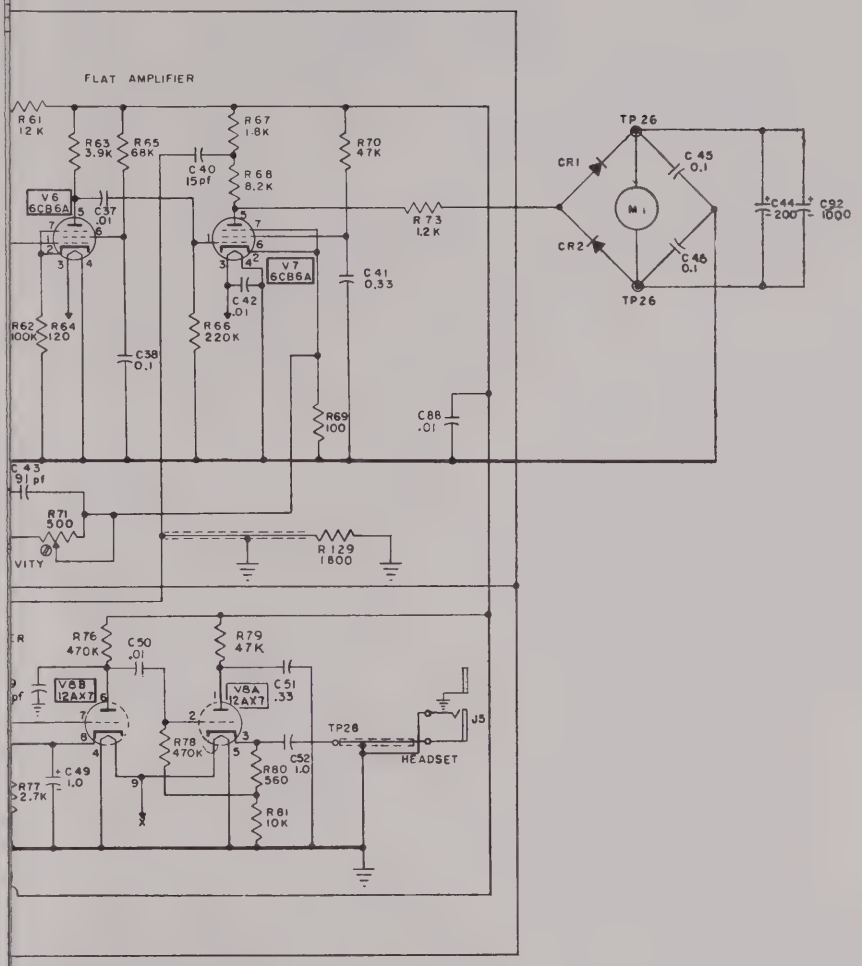


Figure 3-4. Model 125B-CR Schematic Diagram



E14201-58

NOTE:
SYMBOL ○ DESIGNATES FRONT PANEL CONTROL
SYMBOL ⊘ DESIGNATES SCREWDRIVER CONTROL
RESISTOR IN OHMS, (K=1000) (M=1000000)
CAPACITORS IN MICROFARADS (pf=10^{-12} Farad)

LAST SYMBOL USED

R 129	J 5
C 111	T 3
S 4	CR 10
L 18	Y 1
V 13	TP 31

*TEMPERATURE COMPENSATION

odel 125B-Y Schematic Diagram

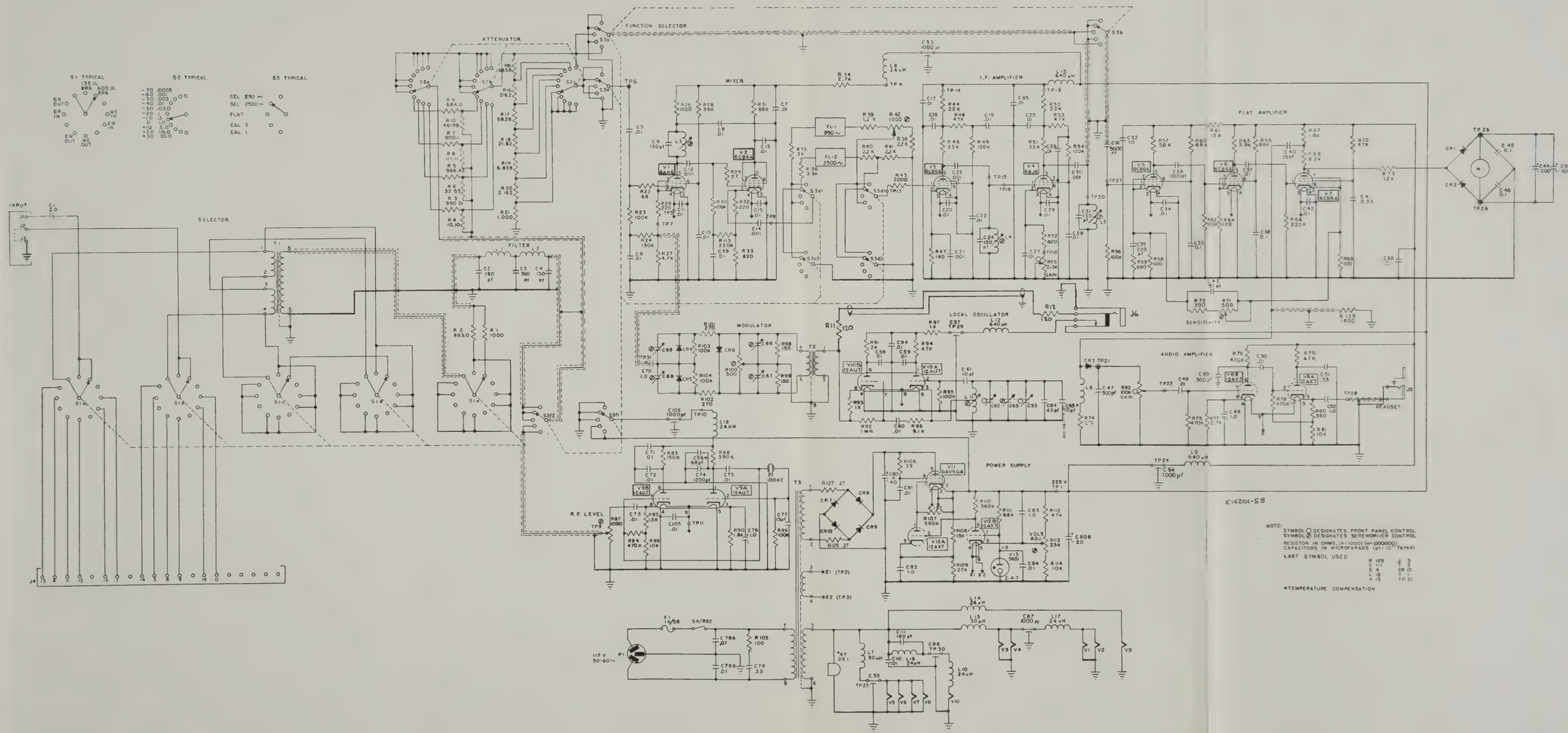


Figure 3-5. Model 125B-Y Schematic Diagram

SECTION IV
REPLACEABLE PARTS LIST

PARTS REPLACEMENT

Standard components have been used in this instrument whenever possible. Both standard and special components may be ordered direct from the factory.

When ordering parts always include:

1. Sierra Stock Number.
2. Circuit Reference and Commercial Description.
3. Name, Model and Serial Number of the instrument.

Parts for this instrument, or further service information may be obtained from:

SIERRA ELECTRONIC OPERATION
Philco-Ford Corporation
3885 Bohannon Drive
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1. INTRODUCTION

a. The following pages list the replaceable parts for Models 125B, 125B-CR and 125B-Y. Those components used only in one model are designated by -B, -CR or -Y following the Schematic Reference number.

REPLACEABLE PARTS LIST

2. TABULAR LISTING

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
C1	CAPACITOR, 2.0 mf, 400Vdcw, Metalized Paper Encapsulated	902420205	Texas	Type #31	1
C2	CAPACITOR, 180 pf, 500Vdcw ±2% Silver Mica	902070181	Elmenco	CM-15E-181G	2
C3	CAPACITOR, 390 pf, 300Vdcw ±2% Silver Mica	902070391	Elmenco	CM-15E-391	1
C4	CAPACITOR, 130 pf, 500Vdcw ±2% Silver Mica	902070131	Elmenco	CM-15E-131G	4
C5	CAPACITOR, .01 mf, 150 Vdcw Disc Ceramic	901440103	Centralab	DDM-103	12
C6	Same as C5				
C7	CAPACITOR, .01 mf, ±20% 600Vdcw Disc Ceramic	901420103	Centralab	DD6-103	28
C8	Same as C7				
C9	Same as C4				
C10	Same as C7				
C11	Same as C5				
C12	CAPACITOR, .001 mf, 500Vdcw Disc Ceramic	901400102	Erie	801-.001	5
C13	Same as C7				
C14	Same as C12				
C15	Same as C5				
C16	Not Used				
C17	Same as C7				
C18	Same as C7				
C19	Same as C7				
C20	Same as C5				
C21	Same as C12				
C22	Same as C7				
C23	Same as C12				
C24	Same as C4				
C25	Same as C7				
C26	Same as C7				
C27	Same as C5				
C28	Same as C7				
C29	Same as C5				
C30	Same as C12				
C31	Same as C4				
C32	CAPACITOR, 1.0 mf, 400Vdcw, Paper PC	902420105	Tex Cap	Type 1017	1
C33	CAPACITOR, .1 mf, 400Vdcw, Paper	901000001	Sprague	4SE-P10	4
C34	Same as C5				
C35	CAPACITOR, 220 pf, 500 Vdcw ±2% Silver Mica	902070221	Elmenco	CM-15E-221	1
C36	CAPACITOR, 1000 pf 500Vdcw ±5% Dur-Mica	901910102	Elmenco	CM-19-102J	1
C37	Same as C7				
C38	Same as C33				
C39	Same as C7				
C40	CAPACITOR, 15 pf, 500Vdcw ±5% Silver Mica	902010150	Elmenco	CM-15C-150J	1
C41	CAPACITOR, .33 mf, 400Vdcw Paper Tubular	901010334	Sprague	4SE-P33	2
C42	Same as C5				
C43	CAPACITOR, 91 pf, 500Vdcw ±5% Silver Mica	901910910	Elmenco	DM-15E-910J	1
C44	CAPACITOR, 200 mf, 6Vdcw Electrolytic	902210207	Sprague	VL-1108	1
C45	Same as C33				
C46	Same as C33				
C47	CAPACITOR, 500 pf ±2% 1000Vdcw Disc Ceramic	901410501	Centralab	DD501	2
C48	Same as C5				
C49	CAPACITOR, 1.0 mf, 50Vdcw Electrolytic	902220105	Sprague	VL-1300	2
C50	Same as C7				
C51	Same as C41				
C52	CAPACITOR, 1.0 mf, 200Vdcw Metalized Paper	902410105	Cornell-Dubilier	MPX2W1	4
C53	CAPACITOR, 1000 pf, 500Vdcw, Ceramic Feed Thru	902630102	Erie	327-102	5
C54	Same as C53				
C55	Same as C53				

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
C56	CAPACITOR, 68 pf, 500Vdcw, ±2%, N330	901410680	Centralab	TCA68	1
C57	Same as C53				
C58	Same as C7				
C59	Same as C7				
C60	Same as C7				
C61	CAPACITOR, 10 pf ±2% NPO Tubular Hi Kap	901420100	Centralab	TCZ-10	1
C62	CAPACITOR, 10-55.7 pf, Variable	902810555	Radio Condenser	SS-12242-1	1
C63	CAPACITOR, 0.7-12 pf, NPO Glass Trimmer	903000120	JFD Electronics	VC-11G	5
C64	CAPACITOR, 43 pf, ±2% NPO Tubular Hi Kap	901410430	Centralab	TCZ-39	1
C65	CAPACITOR, 10 pf, ±2, 1/2%, N330 Tubular HiKap	901430100	Sierra lab	SS-15626-1	1
C66	Same as C63				
C67	Same as C63				
C68	Same as C63				
C69	Same as C63				
C70	Same as C52				
C71	Same as C7				
C72	Same as C7				
C73	Same as C5				
C74	CAPACITOR, 1200 pf, 500Vdcw ±2% Silver Mica	902070122	Elmenco	CM-19E-122	1
C75	Same as C7				
C76	Same as C49				
C77	CAPACITOR, 15 pf, 500Vdcw ±3%, Silver Mica	902070150	Elmenco	CM-15E-150G	1
C78	CAPACITOR, 2X.01 mf, 600 Vdcw Ceramic Disc	901450103	Centralab	DD3-103	2
C79	CAPACITOR, .33 mf, 400Vdcw, Metalized Paper	902410334	Cornell-Dubilier	MPX4P33	1
C80	CAPACITOR, 40-20 mf, 450Vdcw Electrolytic, 85°C	902210402	Sierra	SS-17672-1	1
C81	Same as C7				
C82	Same as C52				
C83	Same as C52				
C84	Same as C7				
C85	Same as C7				
C86	Same as C53				
C87	Same as C53				
C88	Same as C7				
C89	Same as C47				
C90	Not Used				
C91	CAPACITOR, 5600 pf, 600Vdcw ±10% Paper Mylar Sidelead	901100562	Cornell-Dubilier	DPMS6D56	1
C92	CAPACITOR, 1000 mf, 6Vdcw Electrolytic 85°C	902230108	Pyramid	TD-1000-6	1
C93	CAPACITOR, Variable	SU-14217-1	Sierra	SU-14217-1	1
C94	Same as C7				
C95	Not Used				
C96-CR	Same as C5				
C97-CR	Same as C7				
C98-CR	Same as C12				
C99-CR	Same as C18				
C100-CR	CAPACITOR, 33pf, 500Vdcw ±2% Silver Mica	902070330	Elmenco	CM-15E-330	2
C101-CR	CAPACITOR, 5-25 pf	903200250	Erie	TS2A-NPO	2
C102-CR	Same as C101				
C103-CR	Same as C100				
C104-CR	Same as C78				
C105	Same as C7				
C106	Not Used				
C107	Not Used				
C108	Same as C53				
C109	Not Used				
C110	Same as C7				

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
C111	Same as C2				
CR1	DIODE, HD5000, Silicon	910500041	Hughes	HD5000	2
CR2	Same as CR1				
CR3	DIODE, 1N34A Germanium	910500034	Sylvania	1N34A	2
CR4	DIODE, Germanium	910500028	Hughes	1812	2
CR5	Same as CR4				
CR6	Same as CR3				
CR7	RECTIFIER, 600 PIV 750 ma	910800008	Diode Inc.	D156	4
CR8	Same as CR7				
CR9	Same as CR7				
CR10	Same as CR7				
DS1	PILOT LIGHT, Bayonet Base	913800001	National Union	No. 47	1
F1	FUSE, 1.0 Amp. Delay	913200007	Bussman	MDL-1	1
FL1	CRYSTAL FILTER, 2.215 mc, 250 Cycle Bandpass	910100004	Sierra	SS-14486-1	1
FL2	CRYSTAL FILTER, 2.215 mc, 2500 Cycle Bandpass	910100005	Sierra	SS-14485-1	1
J1	BINDING POST, Insulated	915200012	General Radio	938C	2
	BINDING POST, Insulator, Pair	915200014	General Radio	938-BB	1
J2	Same as J1				
J3	BINDING POST, Uninsulated	915200013	General Radio	938A	1
	BINDING POST, Spacer	915200011	General Radio	938F	1
J3-CR	BINDING POST, Grounding	915200003	General Radio	938-WB	1
J4	JACK, Telephone	914400014	Switchcraft	13E-JAX	2
J4-Y	CONNECTOR	914800003	Cinch	47B14515	1
J5	Same as J4				
J6-Y	Same as J4				
L1	INDUCTOR, 340 Microhenries	144221000	Sierra	SS-14422-1	2
L2	Same as L1				
L3	INDUCTOR, 30-38 Microhenries, Variable	127561000	Sierra	SS-12756-1	3
L4	Same as L3				
L5	Same as L3				
L6	INDUCTOR, 100 Microhenries	909000103	J. Millen	J-301-100	1
L7	INDUCTOR, 30 Microhenries	127971000	Sierra	SS-12797-1	2
L8	INDUCTOR, 24 mh, 300 ma	909000097	Miller	4626	6
L9	INDUCTOR, 640 Microhenries	044931000	Sierra	SS-14493-1	3
L10	Same as L8				
L11	INDUCTOR, 20-41 Microhenries	127551000	Sierra	SS-12755-1	1
L12	Same as L9				
L13	Same as L7				
L14	Same as L8				
L15	Same as L9				
L16	Same as L8				
L17	Same as L8				
L18	Same as L8				
M1	METER, 0-1.0 ma dc	911800045	Beede	SS-14218-1	1
P1	POWER CORD with Plug	916400002	Cornish	3533	1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
R1	RESISTOR, 1000 ohm, 1% 1/2W Deposited Carbon	907400080	Electra	DC-1/2C	1
R2	RESISTOR, 893.0 ohm 1%, 1/2W Deposited Carbon	907400081	Electra	DC-1/2C	1
R3	RESISTOR, 990.01 ohm ±1%, 1/2W Deposited Carbon	907400093	Electra	DC-1/2C	1
R4	RESISTOR, 10.10 ohm ±1%, 1/2W Deposited Carbon	907400100	Electra	DC-1/2C	1
R5	RESISTOR, 968.42 ohm ±1%, 1/2W Deposited Carbon	907400094	Electra	DC-1/2C	1
R6	RESISTOR, 32.65 ohm ±1%, 1/2W Deposited Carbon	907400103	Electra	DC-1/2C	1
R7	RESISTOR, 900.1 ohm ±1%, 1/2W Deposited Carbon	907400095	Electra	DC-1/2C	1
R8	RESISTOR, 111.11 ohm ±1%, 1/2W Deposited Carbon	907400097	Electra	DC-1/2C	1
R9	RESISTOR, 684.0 ohm ±1%, 1/2W Deposited Carbon	907400098	Electra	DC-1/2C	1
R10	RESISTOR, 461.98 ohm ±1%, 1/2W Deposited Carbon	907400099	Electra	DC-1/2C	1
R11	RESISTOR, 120 ohm ±5%, 1/2W Fixed Composition	905000121	Allen Bradley	Type EB	3
R12	Same as R11				
R13	Not Used				
R14	Not Used				
R15	RESISTOR, 683.8 ohm ±1%, 1/2W Deposited Carbon	907400022	Electra	DC-1/2C	1
R16	RESISTOR, 216.2 ohm ±1%, 1/2W Deposited Carbon	907400020	Electra	DC-1/2C	1
R17	RESISTOR, 68.38 ohm ±1%, 1/2W Deposited Carbon	90740018	Electra	DC-1/2C	1
R18	RESISTOR, 21.62 ohm ±1%, 1/2W Deposited Carbon	907400017	Electra	DC-1/2C	1
R19	RESISTOR, 6.838 ohm ±1%, 1/2W Deposited Carbon	907400089	Electra	DC-1/2C	1
R20	RESISTOR, 2.162 ohm ±1%, 1/2W Deposited Carbon	907400090	Electra	DC-1/2C	1
R21	RESISTOR, 1.000 ohm ±1%, 1/2W Deposited Carbon	907400091	Electra	DC-1/2C	1
R22	RESISTOR, 68 ohm ±10%, 1/2W Fixed Composition	905200680	Allen Bradley	Type EB	1
R23	RESISTOR, 100,000 ohm ±10%, 1/2W Fixed Comp.	905200104	Allen Bradley	Type EB	6
R24	RESISTOR, 150,000 ohm ±10%, 1/2W Fixed Comp.	905200154	Allen Bradley	Type EB	1
R25	RESISTOR, 1,000 ohm ±5%, 1/2W Fixed Comp.	905000102	Allen Bradley	Type EB	4
R26	RESISTOR, 220 ohm ±5%, 1/2W Fixed Composition	905000221	Allen Bradley	Type EB	2
R27	RESISTOR, 4700 ohm ±5%, 1/2W Fixed Composition	905000472	Allen Bradley	Type EB	1
R28	RESISTOR, 39,000 ohm ±5%, 1/2W Fixed Composition	905000393	Allen Bradley	Type EB	1
R29	RESISTOR, 27 ohm ±10%, 1/2W Fixed Composition	905200270	Allen Bradley	Type EB	1
R30	Same as R23				
R31	RESISTOR, 68,000 ohm ±10%, 1/2W Fixed Composition	905200683	Allen Bradley	Type EB	3
R32	Same as R26				
R33	RESISTOR, 820 ohm ±5%, 1/2W Fixed Composition	905000821	Allen Bradley	Type EB	3
R34	RESISTOR, 2,700 ohm ±5%, 1/2W Fixed Composition	905000272	Allen Bradley	Type EB	2
R35	RESISTOR, 3,000 ohm ±5%, 1/2W Fixed Composition	905000302	Allen Bradley	Type EB	1
R36	RESISTOR, 3,900 ohm ±5%, 1/2W Fixed Composition	905000392	Allen Bradley	Type EB	1
R37	Not Used				
R38	RESISTOR, 2200 ohm ±5%, 1/2W Fixed Composition	905000222	Allen Bradley	Type EB	3
R39	RESISTOR, 1,200 ohm ±5%, 1/2W Fixed Composition	905000122	Allen Bradley	Type EB	1
R40	Same as R38				
R41	Same as R38				
R42	POTENTIOMETER 1000 ohm, Type UPE-70	907900105	CTS	32275	2
R43	RESISTOR, 2000 ohm ±5%, 1/2W Fixed Composition	905000202	Allen Bradley	Type EB	2
R44	RESISTOR, 22,000 ohm ±10%, 1/2W Fixed Comp.	905200223	Allen Bradley	Type EB	2
R45	Not Used				
R46	RESISTOR, 33,000 ohm ±10%, 1/2W Fixed Comp.	905200333	Allen Bradley	Type EB	2
R47	RESISTOR, 180 ohm ±5%, 1/2W Fixed Composition	905000181	Allen Bradley	Type EB	1
R48	RESISTOR, 47,000 ohm ±10%, 1/2W Fixed Comp.	905200473	Allen Bradley	Type EB	4
R49	RESISTOR, 120,000 ohm ±10%, 1/2W Fixed Comp.	905200124	Allen Bradley	Type EB	2
R50	Same as R44				
R51	Same as R46				
R52	Same as R33				
R53	Same as R48				
R54	Same as R49				
R55	POTENTIOMETER, 2,500 ohm 2W Composition	907900152	CTC	HT 321-#35774	1
R56	Same as R23				

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
R57	RESISTOR, 5,600 ohm ±10%, 1/2W Fixed Composition	905200562	Allen Bradley	Type EB	1
R58	RESISTOR, 100 ohm ±5%, 1/2W Fixed Composition	905000101	Allen Bradley	Type EB	2
R59	RESISTOR, 680 ohm ±5%, 1/2W Fixed Composition	905000681	Allen Bradley	Type EB	1
R60	Same as R31				
R61	RESISTOR, 12,000 ohm ±10%, 1/2W Fixed Comp.	905200123	Allen Bradley	Type EB	1
R62	Same as R23				
R63	RESISTOR, 3,900 ohm ±10%, 1W Fixed Composition	905600392	Allen Bradley	Type GB	1
R64	Same as R11				
R65	Same as R31				
R66	RESISTOR, 220,000 ohm ±10%, 1/2W Fixed Comp.	905200224	Allen Bradley	Type EB	4
R67	RESISTOR, 1800 ohm ±5%, 1/2W Fixed Composition	905000182	Allen Bradley	Type EB	3
R68	RESISTOR, 8,200 ohm ±5%, 1W Fixed Composition	905400822	Allen Bradley	Type GB	1
R69	Same as R58				
R70	Same as R48				
R71	POTENTIOMETER, 500 ohm, 1/2W Taper 1	907900100	Stackpole	LH61	1
R72	RESISTOR, 390 ohm ±5%, 1/2W Fixed Composition	905000391	Allen Bradley	Type EB	1
R73	RESISTOR, 1200 ohm ±10%, 1/2W Fixed Composition	905200122	Allen Bradley	Type EB	1
R74	RESISTOR, 270 ohm ±10%, 1/2W Fixed Composition	905200271	Allen Bradley	Type EB	1
R75	RESISTOR, 470,000 ohm ±10%, 1/2W Fixed Comp.	905200474	Allen Bradley	Type EB	4
R76	Same as R75				
R77	Same as R34				
R78	Same as R75				
R79	Same as R48				
R80	RESISTOR, 560 ohm ±5%, 1/2W Fixed Compsotion	905000561	Allen Bradley	Type EB	1
R81	RESISTOR, 10,000 ohm ±10%, 1/2W Fixed Comp.	905200103	Allen Bradley	Type EB	2
R82	POTENTIOMETER, 100,000 ohm 2W Comp. Switch Section	907900071	Sierra	SS-393-3-45	1
R83	RESISTOR, 150,000 ohm ±5%, 1/2W Fixed Comp.	905000154	Allen Bradley	Type EB	1
R84	Same as R75				
R85	RESISTOR, 1500 ohm ±5%, 1/2W Fixed Composition	905000152	Allen Bradley	Type EB	1
R86	Same as R81				
R87	Same as R42				
R88	RESISTOR, 390,000 ohm ±5%, 1/2W Fixed Comp.	905000394	Allen Bradley	Type EB	1
R89	Same as R23				
R90	Same as R67				
R91	Same as R43				
R92	RESISTOR, 1 Meg. ohm ±10%, 1/2W Fixed Comp.	905200105	Allen Bradley	Type EB	1
R93	Same as R25				
R94	RESISTOR, 47,000 ohm ±5%, 1/2W Fixed Comp.	905000473	Allen Bradley	Type EB	1
R95	Same as R23				
R96	RESISTOR, 9,100 ohm ±5%, 1/2W Fixed Comp.	905000912	Allen Bradley	Type EB	1
R97	Same as R25				
R98	RESISTOR, 150 ohm ±5%, 1/2W Fixed Composition	905000151	Allen Bradley	Type EB	2
R99	Same as R98				
R100	POTENTIOMETER, 500 ohm, 1/4W Composition (Lug Terminals)	907900102	Allen Bradley	Type R	1
R101	RESISTOR, 270 ohm ±5%, 1/2W Fixed Composition	905000271	Allen Bradley	Type EB	2
R102	Same as R101				
R103	RESISTOR, 100,000 ohm ±5%, 1/2W Fixed Comp.	905000104	Allen Bradley	Type EB	5
R104	Same as R103				
R105	RESISTOR, 100 ohm ±10%, 1/2W Fixed Composition	905200101	Allen Bradley	Type EB	1
R106	RESISTOR, 39 ohm ±10%, 1/2W Fixed Composition	905200390	Allen Bradley	Type EB	1
R107	RESISTOR, 560,000 ohm ±5%, 1/2W Fixed Comp.	905000564	Allen Bradley	Type EB	2
R108	RESISTOR, 15,000 ohm ±5%, 2W Fixed Composition	905800153	Allen Bradley	Type HB	1
R109	RESISTOR, 22,000 ohm ±5%, 2W Fixed Composition	905800223	Allen Bradley	Type HB	1

031364

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
R110	Same as R107				
R111	RESISTOR, 68,000 ohm ±5%, 1W Fixed Composition	905400683	Allen Bradley	Type GB	1
R112	RESISTOR, 47,000 ohm ±5%, 1W Fixed Composition	905400473	Allen Bradley	Type GB	1
R113	POTENTIOMETER, 25,000 ohm, Printed Circuit Type Taper 1	907900103	Stackpole	LH61	1
R114	RESISTOR, 10,000 ohm ±5%, 1/2W Fixed Composition	905000103	Allen Bradley	Type EB	2
R115	Same as R66				
R116-CR	Same as R33				
R117-CR	Same as R25				
R118-CR	RESISTOR, 56K ±5%, 1/2W Fixed Composition	905000563	Allen Bradley	Type EB	1
R119-CR	RESISTOR, 68 ohm ±5%, 1/2W Fixed Composition	905000680	Allen Bradley	Type EB	1
R120-CR	Same as R114				
R121-CR	Same as R103				
R122-CR	Same as R103				
R123-CR	Same as R66				
R124-CR	Same as R66				
R125-CR	Same as R103				
R126	Not Used				
R127	RESISTOR, 27 ohm ±5%, 1W Fixed Composition	905400270	Allen Bradley	Type GB	2
R128	Same as R127				
R129	Same as R67				
R129-CR	Not Used				
S1	SWITCH, Selector	911200059	Sierra	SS-14194-1	1
S1-Y	SWITCH, Selector	911200057	Sierra	SS-14204-1	1
S2	SWITCH, Selector, 3 pole, 11 position, 4 section	911200056	Sierra	SS-14205-1	1
S3	SWITCH, Selector, 9 pole, 5 position, 6 section	911200046	Sierra	SS-12455-1	1
S4	SWITCH, On-Off, (Part of R82 Potentiometer)	907900071	Sierra	SS-393-3-45	1
S5-CR	SWITCH, Selector, 2 pole, 3 position, 1 section	911200058	Sierra	SS-14206-1	1
T1	TRANSFORMER, 600-135 ohm/2000 ohm 1 kc to 620 kc	141893000	Sierra	SU-14198-3	1
T2	TRANSFORMER, 2:1 turns ratio, Frequency Range 2.2 mc to 2.9 mc	141592000	Sierra	SU-14159-2	1
T3	TRANSFORMER, Power, Sec.#1:250 rms @ 75 ma: DC Sec.#2:63 Vrms@4A Sec. #3:6.3 Vrms @ 1:6A Primary 115V/230V rms 50/1000 cps	910000071	Sierra	A02029800A	1
V1	VACUUM TUBE, Sharp Cut - Off Pentode	910700074	RCA	6AH6	1
V2	VACUUM TUBE, Sharp Cut - Off Pentode	910700059	RCA	6CB6A	5
V3	Same as V2				
V4	VACUUM TUBE, Sharp Cut - Off Pentode	910700075	RCA	6BJ6	1
V5	Same as V2				
V6	Same as V2				
V7	Same as V2				
V8	VACUUM TUBE, Twin Triode	910700069	RCA	12AX7	2
V9	VACUUM TUBE, Twin Triode	910700052	RCA	12AU7	2
V10	Same as V9				
V11	VACUUM TUBE, Pentode	910700076	RCA	6AV6GA	1
V12	Same as V8				
V13	GAS TUBE, Voltage Reference	910700015	RCA	5651	1
V14	VACUUM TUBE, Triple Triode	910700088	Sylvania	6EZ8	1
XDS1	PILOT LIGHT, Holder	914200008	Dialco	7-04	1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
XF1	FUSE HOLDER	913400001	Littlefuse	342003	1
XV1	TUBE SOCKET, 7 pin miniature for printed board	914000036	Methode	P455	8
XV2	Same as XV1				
XV3	Same as XV1				
XV4	Same as XV1				
XV5	Same as XV1				
XV6	Same as XV1				
XV7	Same as XV1				
XV8	TUBE SOCKET, 9 pin Noval for printed board	914000037	Methode	P465	4
XV9	Same as XV8				
XV10	TUBE SOCKET, Turret	914000032	Vector Electronic	8N12T	1
XV11	TUBE SOCKET, Octal for printed board	914000035	Elco	611PH-1/6	1
XV12	Same as XV8				
XV13	Same as XV1				
XV14-CR	Same as XV8				
XY1	CRYSTAL, Holder, Ceramic	914200021	Johnson	126-105	1
XY2-CR	Same as XY1				
XY3-CR	Same as XY1				
Y1	CRYSTAL, Quartz 100 kc, .02%	912200009	Bliley Electric	SS-13109-1	1
Y2-CR	CRYSTAL, Quartz 2,213.5 kc .005%	912200011	Sierra	SS-13417-1	1
Y3-CR	CRYSTAL, Quartz 2,216.5 kc .005%	912200012	Sierra	SS-13418-1	1
	SHORTING LINK	915200007	General Radio	938-L	1

PHILCO-FORD CORPORATION
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TELEPHONE (415) 322-7222 TWX 910-373-1282

Warranty

SIERRA ELECTRONIC OPERATION, PHILCO-FORD CORPORATION warrants instruments manufactured by it and bearing Sierra commercial model numbers, except Infrared Cells, to be free from defective material and factory workmanship and agrees to repair such instruments, which under normal use and service, disclose the defects to be the fault of our manufacturing. Our obligation under this warranty is limited to repairing any such instrument which in our sole opinion upon our examination proves to be so defective, when returned to our factory at 3885 Bohannon Drive, Menlo Park, California 94025, transportation prepaid by the purchaser, within one year from the date of original purchase from us.

This warranty does not apply to any products which have been repaired, worked upon or altered by persons not authorized by us so as, in our sole judgement, to injure the stability or reliability of such instrument, or which have been subject to misuse, negligence or accident, or the serial number of which has been altered, effaced, or removed. Neither does this warranty apply to any of our products which have been connected, installed, used or adjusted otherwise than in accordance with the instructions furnished by us. Nor does SIERRA assume any liability for consequential damages, and in any event our liability shall in no case exceed the original purchase price of the instrument. Accessories, including but not limited to all vacuum tubes, fuses and batteries, not of our manufacture used with this product are not covered by this warranty.

SIERRA reserves the right to make changes in the design or construction of any of its instruments at any time without incurring any obligation to make any changes whatever on units previously purchased.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to represent nor assume for us any liability in connection with the sale of our products other than set forth herein. In no event will seller be liable for any incidental or consequential damages.